IRON HORSE BUSINESS CENTER REZONING

(FORMERLY EAST ASHLAND – TRADEPORT95)

Chapter 527 Traffic Impact Analysis

August 2022
Revised February 2023

Prepared For:

WestDulles Properties Inc.
Hanover County
Town of Ashland
Virginia Department of Transportation (VDOT)

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

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1 EXECUTIVE SUMMARY

This report presents the findings of the traffic impact analysis prepared for WestDulles Properties' rezoning of the project site in Hanover County and the Town of Ashland, Virginia.

1.1 PROJECT OVERVIEW

The proposed development is located to the south of Route 54 (Patrick Henry Hwy), east of I-95, and west of Woodside Lane in both Hanover County and the Town of Ashland as shown on Figure 1-1 (all figures located at the end of their respective chapter).

East Ashland is currently zoned as a Planned Unit Development (PUD) within the Town of Ashland and mixed use (MX) within Hanover County. The Applicant is proposing to rezone a portion of the site to Business (B-2 Ashland; B-3 Hanover) and Light Industrial (M-1 Ashland; M-2 Hanover) which will accommodate the development.

The Applicant is proposing to develop the site in two (2) phases, consisting of the following (with the understanding that explicit site plans will be required for each part of development):

- 12 fuel pumps – Gas Station
- 26,000 S.F. – Medical Office
- 26,000 S.F. – General Office
- 21,000 S.F. – Sit-Down Restaurant (High-Turnover)
- 8,000 S.F. – Fast Food Restaurant with Drive-Thru
- 1,940,000 S.F. – Industrial Park
- 130 rooms – Hotel
- 146 units - Townhomes

The buildout of the development is anticipated to occur between 2027 and 2032. For the purposes of this analysis, Phase 1 will be completed by 2027 and will include 100% of the residential townhomes only. Phase 2 will be completed by 2027 and includes 40% of the overall retail, office, and industrial land uses. Phase 3 will be completed by 2032 and includes the remaining 60% of the overall retail, office, and industrial land uses. A conceptual site plan is shown on Figure 1-2.

Access to the site will be provided via two (2) driveways connecting to Route 54 (Entrances A and B) and two (2) driveways connecting Mt. Hermon Road (Entrances C and D). One (1) driveway on Mt. Hermon Road will be for the retail/industrial component of the proposed development and one (1) driveway will be for the residential townhomes.

The site plan provided is intended for informational purposes only and is conceptual in nature. The proposed driveways shown do not represent the final site layout and are subject to site plan approval with the Town, County, and VDOT. Therefore, for the purposes of this analysis, it was assumed that there would be no partial access driveways along the parcel's frontage on Route 54. Additionally, the three (3) driveways connecting to Mt. Hermon Road for the retail, office, and industrial portion of the proposed development were consolidated to one access point for simplification. The two (2) driveways connecting to Mt. Hermon Road for the townhomes were consolidated to one access point for simplification. All proposed entrances will require entrance permit approval at such time that development plans occur.

As shown in Table 8-1, when complete, the total proposed development will generate 1,251 net external trips (869 in and 382 out) during the AM peak, 1,322 net external trips (458 in and 864 out) during the PM peak, and 11,812 net external weekday daily trips. The total proposed development will generate 342 total pass-by trips (176 in and 166 out) during the AM peak, 269 total pass-by trips (145 in and 124 out) during the PM peak, and 4,047 total pass-by weekday daily trips.

Phase 1 (residential townhomes only) of the proposed development will generate 70 external trips (22 in and 48 out) during the AM peak, 84 external trips (48 in and 36 out) during the PM peak, and 1,062 external weekday daily trips.

Phase 2 (40% of the retail, office, and industrial land uses) of the proposed development will generate 472 net external trips (339 in and 134 out) during the AM peak, 495 net external trips (164 in and 331 out) during the PM peak, and 4,300 net external weekday daily trips.

Phase 3 (60% of the retail, office, and industrial land uses) of the proposed development will generate 709 net external trips (508 in and 200 out) during the AM peak, 743 net external trips (246 in and 497 out) during the PM peak, and 6,450 net external weekday daily trips.

The purpose of this analysis is to determine the impact of the traffic generated by the proposed development on the surrounding roadway network. The scope of this study was developed in conjunction with the Virginia Department of Transportation (VDOT), Town of Ashland, and Hanover County staff at a scoping meeting held virtually on March 18, 2022. A copy of the scoping agreement is included in Appendix A.

1.2 STUDY LIMITS

As outlined in the scoping agreement, the study limits include the following 10 existing intersections (see Figure 1-1):

1. Route 54 and US Route 1 (Washington Hwy) (signalized);
2. Route 54 and Cottage Green Drive (signalized);
3. Route 54 and Hill Carter Parkway (signalized);
4. Route 54 and Carter Road (unsignalized);
5. Route 54 and I-95 SB ramps (unsignalized);
6. Route 54 and I-95 NB ramps (unsignalized);
7. Route 54 and Telecourt Road (unsignalized);
8. Route 54 and Mt. Hermon Road (unsignalized);
9. Route 54 and Woodside Lane (unsignalized); and
10. Route 54 and Goddins Hill Road (unsignalized).

In accordance with the scoping agreement, analyses were completed for the weekday AM and PM peak hours for the following scenarios:

1. 2022 Existing Traffic Conditions
2. 2027 Background Traffic Conditions (without the development of the site)
3. 2027 Future Traffic Conditions (with the development of Phase 1 of the site)
4. 2027 Future Traffic Conditions (with the development of Phases 1 and 2 of the site)
5. 2032 Background Traffic Conditions (without the development of the site)
6. 2032 Future Traffic Conditions (with total development of the site – Phases 1, 2, and 3)
7. 2038 Background Traffic Conditions (without the development of the site)
8. 2038 Future Traffic Conditions (with total development of the site – Phases 1, 2, and 3)

The following steps were taken to determine the potential traffic impacts associated with this project:

1. Data Collection – Directional turning movement counts (TMCs) were conducted at the study intersections on May 5, 2022 when public schools were in session. In addition, 12-hour TMCs were collected at the intersection of Route 54/Mt. Hermon Rd. The TMCs were comparable to the 2019 VDOT average daily traffic along Route 54. Therefore, in agreement with VDOT, the Town of Ashland, and Hanover County, the 2022 peak hour TMCs were not adjusted for COVID factors since the counts indicate normal traffic conditions in the study area.

2. Traffic Growth – In order to be conservative and account for development outside the study area, a 1.5% annual growth rate was applied to the study area road network. The growth rate was compounded annually for each future scenario.

3. Other Development Trip Generation – The traffic generated by one (1) other development in the vicinity was included in the analyses under background conditions, including improvements to the roadway network proffered by the other development.

4. Trip Generation – Traffic generated by the proposed development was estimated using the 11th Edition of the Institute of Transportation Engineers' *Trip Generation Manual.*

5. Traffic Distributions – The distribution of trips generated by the proposed development was based on the existing traffic volumes, the nature of the proposed uses, and the surrounding roadway network.

6. Traffic Projections – Future traffic volumes were determined using the existing traffic counts, the 1.5% growth rate noted above, the trips generated by the other approved development, and the trips generated by the site.

7. Traffic Capacity Analysis – Level of service calculations for existing, background, and future conditions were performed using SYNCHRO for signalized and unsignalized intersections and SIDRA for the existing/proposed roundabouts.

8. Queuing Analysis – The simulated maximum and SIDRA/HCS 95th percentile queue lengths were reviewed at the study intersections to determine turn lane storage needs.

This traffic impact analysis (TIA) has been prepared in accordance with (1) the procedures outlined in the VDOT Traffic Impact Analysis Regulations (henceforth referred to as Chapter 527), (2) the VDOT Traffic Operations and Safety Analysis Manual (TOSAM), and (3) the Scope of Study agreed upon between Hanover County, VDOT, Town of Ashland, and Timmons Group (See Appendix A for scoping agreement).

1.3 PRINCIPAL FINDINGS

The 2022 existing conditions analysis indicates that the Route 54 corridor operates well during both peak hours. No major queueing or delay challenges are noted at the study intersections, with the exception of the southbound approach failing at Route 54/I-95 SB on/off ramp intersection.

Under 2027, 2032, and 2038 Background analyses, the Route 54 corridor is able to handle increases in traffic volumes without degrading operations until year 2038. By 2038, many movements at Route 54/US Route 1 are over capacity and excessive queues impact operations of the overall intersection.

Phase 1 of the Iron Horse Business Center development (2027) will be accommodated through constructing VDOT-approved standard turn lanes at the intersection of and Mt. Hermon Road with Route 54. Phase 1 consists of the residential townhome development only.

Phase 2 of the Iron Horse Business Center development (2027) will be accommodated through constructing VDOT-approved standard turn lanes at the intersections of Site Entrances A and B with Route 54, increasing the storage to 400 feet for the southbound left/through at the intersection of I-95 SB ramp with Route 54, and installing a traffic signal (or a VDOT approved alternative) at the intersection of Mt. Hermon Road with Route 54. Phase 2 consists of 40% of the overall retail, office, and industrial land uses.

Phase 3 of the Iron Horse Business Center development (2032) will be accommodated through installing traffic signals (or a VDOT approved alternative) at the intersections of Site Entrance A and the I-95 SB ramp with Route 54. The remainder of the site entrances can continue to be served by the improvements constructed during Phase 1 or 2 of development. Phase 3 consists of the remaining 60% of the overall retail, office, and industrial land uses not constructed during Phase 2.

At Route 54/Mt. Hermon Road, the eastbound approach will be modified to have one (1) left turn lane, one (1) through lane, and one (1) right turn lane. The right turn lane will become a drop lane for eastbound traffic. One (1) left turn lane will be added to the westbound approach. At Route 54/Site Entrance A, one (1) left turn lane and one (1) right turn lane will be constructed. At Route 54/Site Entrance B, one (1) left turn lane will be constructed.

With the site improvements described above and under 2027, 2032, and 2038 Total conditions, there are no significant capacity or queueing issues noted at the study intersections beyond those background issues previously noted. Retiming traffic signals along Route 54 will provide added capacity to the corridor. A signal at the Route 54/I-95 SB on/off ramp is able to accommodate the proposed development's trips. The installation of traffic signals on Route 54 at Mt. Hermon Road and Site Entrance A are able to accommodate the proposed site traffic without significantly impacting operations to the mainline of Route 54.

It is understood that any recommended traffic signals will require further signal warrant analysis and a signal justification report at such time that proposed site plan development creates the necessary volumes on Route 54. VDOT approved alternative options for the interchange ramps and Route 54 will need to be reviewed to determine the best solution from a safety and operational perspective.

1.4 RECOMMENDATIONS

The focus of this report is to identify a comprehensive access plan that provides functional access to the site and preserves the capacity of the surrounding roadway network. This report identifies the proposed phasing of the Iron Horse Business Center development and the roadway improvements associated with each phase.

To accommodate the anticipated traffic associated with the Iron Horse Business Center development, the recommended improvement plan is as follows:

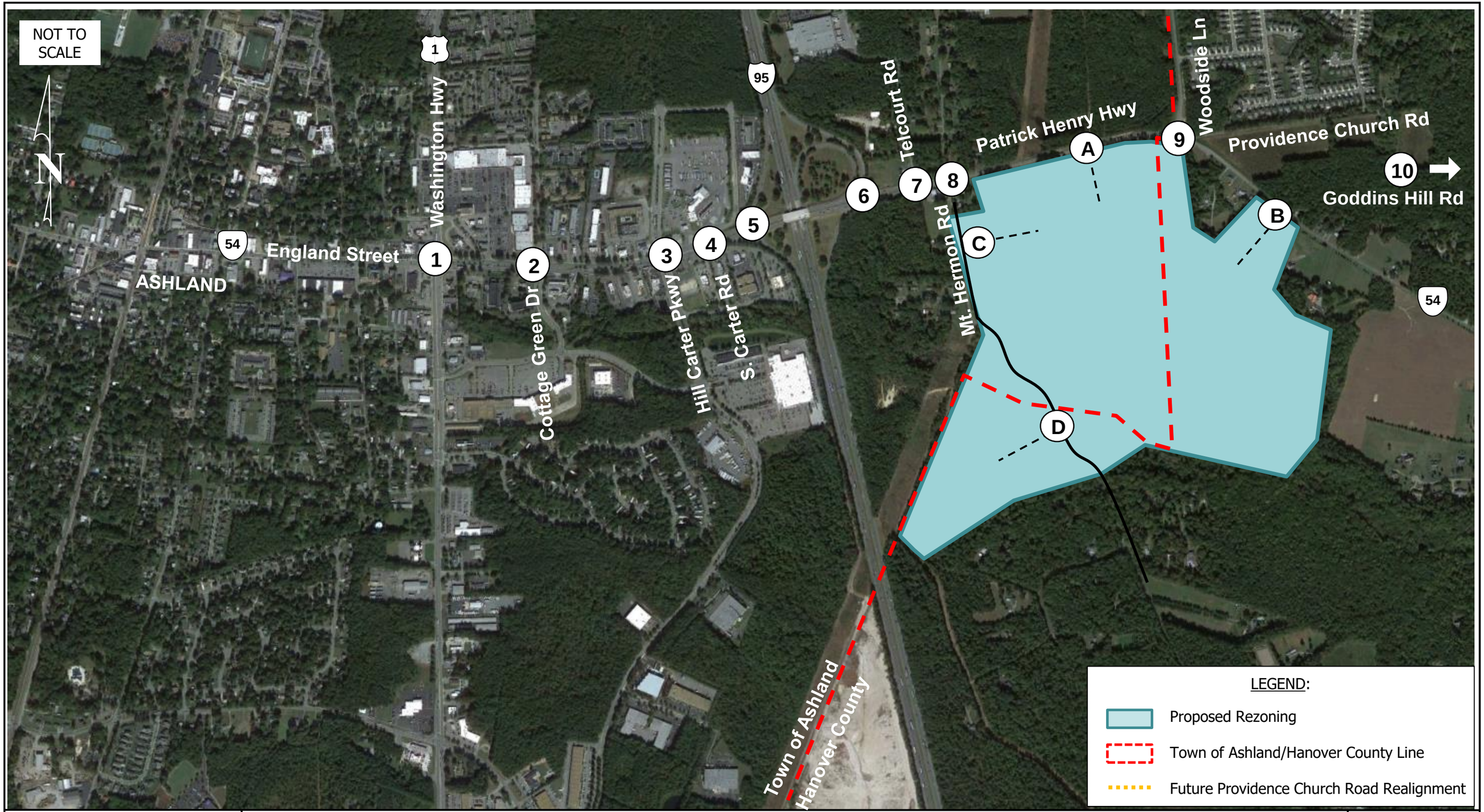
- Route 54 at Site Entrance A
  - Phase 2
    - Construct eastbound and westbound left turn lanes.
  - Phase 3
    - Install new traffic signal (or a VDOT-approved alternative).

- Route 54 at Site Entrance B
  - Phase 2
    - Construct westbound left turn lane.

- Route 54 at Mt. Hermon Rd.
  - Phase 1
    - Construct eastbound and westbound left turn lanes.
    - Eastbound right turn lane – modify the eastbound approach to have one (1) left turn lane, one (1) through lane, and one (1) right turn lane. The right turn lane will be a drop lane.
  - Phase 2
    - Install new traffic signal (or a VDOT-approved alternative).

- Route 54 at I-95 SB ramp
  - Phase 2
    - Construct approximately 400' of additional storage for the SB shared left/through lane to accommodate queuing and remove any impacts to mainline I-95 SB.
  - Phase 3
    - Install new traffic signal (or a VDOT-approved alternative).

Given the preliminary nature of the development plan, the exact location of the site entrances along Route 54 (or other internal site roadways) will be defined during the site plan stage. However, it is noted that Site Entrance A must be spaced at least 1,050 feet away (center to center) from Mt. Hermon Road to meet minimum access management standards for spacing between traffic signals. All construction of roadway improvements is subject to Town, County, and VDOT approval, including assistance on obtaining any required right-of-way not owned by the Applicant. Additional entrances to individual parcels within the development, or other modifications to access along Route 54 that may be developed as part of the site plan review process, are not explicitly discussed within this report.



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VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
Vicinity Map / Study Intersections

Figure
1-1

NOT TO SCALE

TIMMONS GROUP YOUR VISION ACHIEVED THROUGH OURS.	VDOT Chapter 527 TIA Iron Horse Business Center Rezoning Conceptual Site Plan	Figure 1-2

2 BACKGROUND INFORMATION

2.1 DESCRIPTION OF ON-SITE DEVELOPMENT

The proposed development is located to the south of Route 54 (Patrick Henry Hwy), east of I-95, and west of Woodside Lane in both Hanover County and the Town of Ashland as shown on Figure 1-1 (all figures located at the end of their respective chapter).

East Ashland is currently zoned as a Planned Unit Development (PUD) within the Town of Ashland and mixed use (MX) within Hanover County. The Applicant is proposing to rezone a portion of the site to Business (B-2 Ashland; B-3 Hanover) and Light Industrial (M-1 Ashland; M-2 Hanover) which will accommodate the proposed development.

The buildout of the development is anticipated to occur between 2027 and 2032. For the purposes of this analysis, Phase 1 will be completed by 2027 and will include 100% of the residential townhomes only. Phase 2 will be completed by 2027 and includes 40% of the overall retail, office, and industrial land uses. Phase 3 will be completed by 2032 and includes the remaining 60% of the overall retail, office, and industrial land uses. A conceptual site plan is shown on Figure 1-2.

Access to the site will be provided via two (2) driveways connecting to Route 54 (Entrances A and B) and two (2) driveways connecting Mt. Hermon Road (Entrances C and D). One (1) driveway on Mt. Hermon Road will be for the retail/industrial component of the proposed development and one (1) driveway will be for the residential townhomes.

The site plan provided is intended for informational purposes only and is conceptual in nature. The proposed driveways shown do not represent the final site layout and are subject to site plan approval with the Town, County, and VDOT. Therefore, for the purposes of this analysis, it was assumed that there would be no partial access driveways along the parcel's frontage on Route 54. Additionally, the three (3) driveways connecting to Mt. Hermon Road for the retail, office, and industrial portion of the proposed development were consolidated to one access point for simplification. The two (2) driveways connecting to Mt. Hermon Road for the townhomes were consolidated to one access point for simplification. All proposed entrances will require entrance permit approval at such time that development plans occur.

2.2 STUDY LIMITS

As outlined in the scoping agreement, the study limits include the following 10 existing intersections:

1. Route 54 and US Route 1 (Washington Hwy) (signalized);
2. Route 54 and Cottage Green Drive (signalized);
3. Route 54 and Hill Carter Parkway (signalized);
4. Route 54 and Carter Road (unsignalized);
5. Route 54 and I-95 SB ramps (unsignalized);
6. Route 54 and I-95 NB ramps (unsignalized);
7. Route 54 and Telecourt Road (unsignalized);
8. Route 54 and Mt. Hermon Road (unsignalized);
9. Route 54 and Woodside Lane (unsignalized); and
10. Route 54 and Goddins Hill Road (unsignalized).

2.3 EXISTING ROADWAYS

Route 54 (England Street/Patrick Henry Hwy) is a divided highway with six lanes between US Route 1 and I-95. It is an undivided 2-lane roadway outside this segment. It is functionally classified as a Minor Arterial and has a posted speed limits of 25 mph west of US Route 1, 35 mph between US Route 1 and Carter Rd, 45 mph between Carter Rd and Woodside Ln, and 55 mph east of Woodside Ln. According to the 2019 VDOT Traffic Counts, Route 54 carries approximately 25,000 vehicles per day between US Route 1 and I-95 and 6,000 vpd between I-95 and eastern Ashland Town Line. The roadway only has sidewalks west of Hill Carter Pkwy. There are no on-street bike lanes in the study area.

Hill Carter Parkway is a four-lane divided roadway with auxiliary turning lanes. It is functionally classified as a major collector with a posted speed limit of 35 mph. There are sidewalks along one side and shared-use path on the other side. There are no on-street bike lanes.

Goddins Hill Road is a two-lane undivided roadway functionally classified as a major collector with a speed limit of 45 mph. According to the 2019 VDOT Traffic Counts, Goddins Hill Road carries approximately 820 vehicles per day. The roadway does not have sidewalks or on-street bike lanes.

The remaining roadways within the study area are functionally classified as local roadways and are generally two-lane undivided roadways with a posted speed limit of 25 mph, with the exception of Mt. Hermon Road that has a posted speed limit of 40 mph. Only Cottage Green Drive has sidewalks of these local roads; all roadways have no on-street bike lanes.

The 2022 existing lane use and traffic control at the study intersections is shown on Figure 2-1.

2.4 FUTURE IMPROVEMENTS

The proposed development will construct improvements at the intersections of Route 54 with the two (2) site entrances, at the intersection of Route 54/Mt. Hermon Rd, and at the intersection of Route 54/I-95 SB on/off ramp.

Improvements recommended with Phase 1 of the proposed development (completed by 2027):

- Route 54 and Mt. Hermon Rd.
  - Construct 100' storage x 100' taper WB left turn lane
  - Modify the eastbound approach to have a 100' x 100' left turn lane, one through lane, and one right turn lane. The right turn lane will be a drop lane.

Improvements recommended with Phase 2 of the proposed development (completed by 2027):

- Route 54 and Site Entrance A
  - Construct 100' storage x 100' taper WB left turn lane
  - Construct 100' storage x 100' taper EB right turn lane

- Route 54 and Site Entrance B
  - Construct 200' storage x 200' taper WB left turn lane

- Route 54 and Mt. Hermon Rd.
  - Install new traffic signal (or a VDOT-approved alternative).

- Route 54 and I-95 SB ramp
  - Construct approximately 400' of additional storage for the SB shared left/through lane.

Improvements recommended with Phase 3 of the proposed development (completed by 2032):

- Route 54 and Site Entrance A
  - Install new traffic signal (or a VDOT-approved alternative).

- Route 54 and I-95 SB ramp
  - Install new traffic signal (or a VDOT-approved alternative).

For the purposes of this analysis, it was assumed that the above improvements would be completed with buildout of their respective phase and were analyzed starting in with the years that each respective phase is expected to be completed.

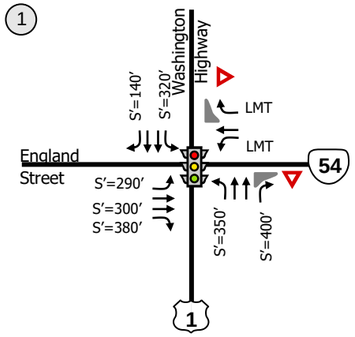
Based on information contained in the 2015 Ashland Transportation Plan, the Town and Hanover County have long-range plans to reconstruct the Route 54/I-95 interchange as a diverging diamond interchange. This project has been submitted to VDOT's SMART SCALE but has not received committed funding to date. As such, there is no timeline for the project and the diverging diamond interchange was not analyzed as part of this report.

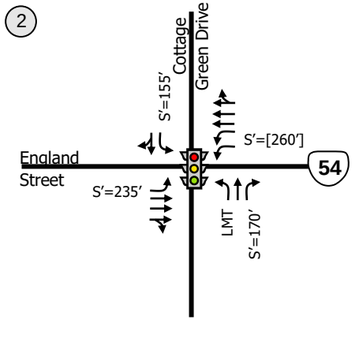
The future lane uses and traffic control at the study intersections are shown on Figure 2-2 (Phase 1), Figure 2-3 (Phase 2), and Figure 2-4 (Phase 3).

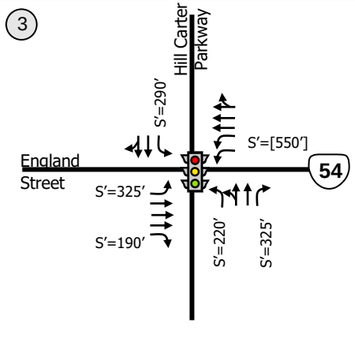
It was assumed that VDOT will retime the traffic signals along Route 54 periodically due to expected background development and overall growth in the study area. To reflect this, the traffic signal timings and offsets were optimized for all future conditions (2027, 2032, and 2038).

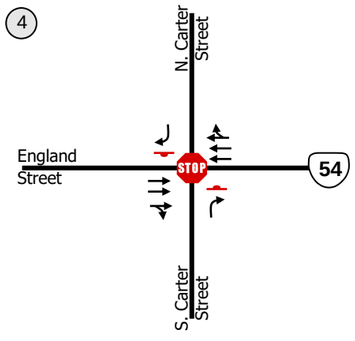
2.5 OTHER MODES OF TRANSPORTATION

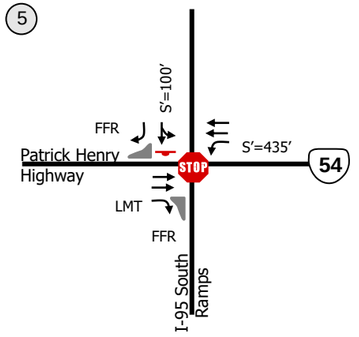
Currently, there are no sidewalks/shared use paths in the vicinity of the project site as outlined in Section 2.3. The sidewalks/paths do not form a network connecting to other roadways inside or outside the study area. There are currently no transit routes within the study area.

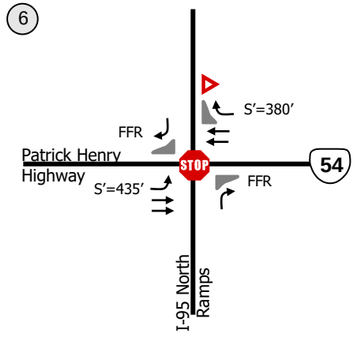


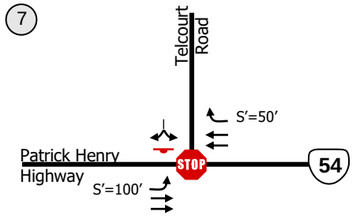


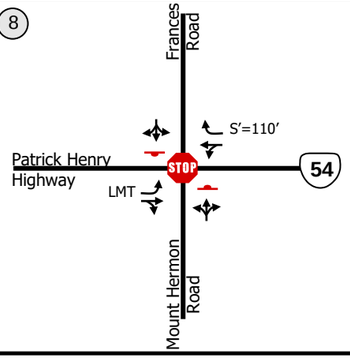


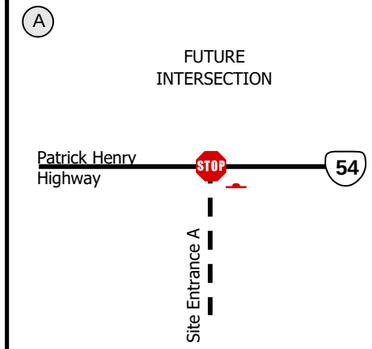


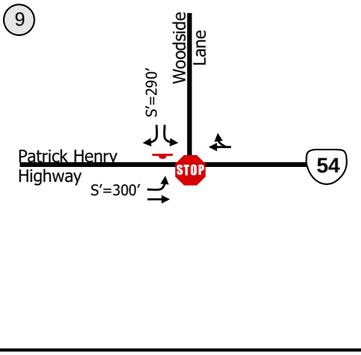


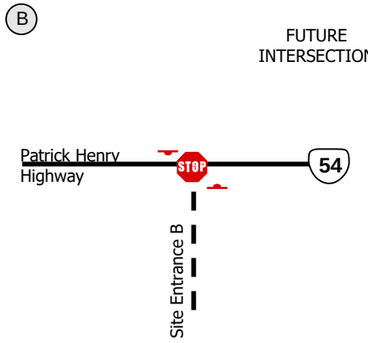


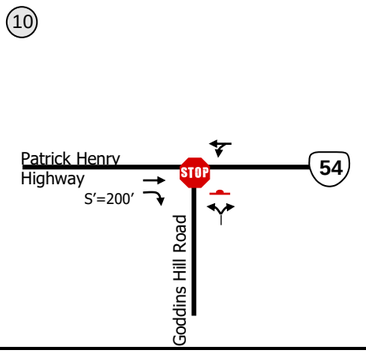








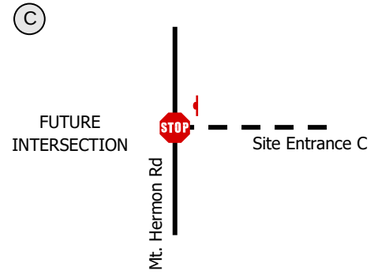


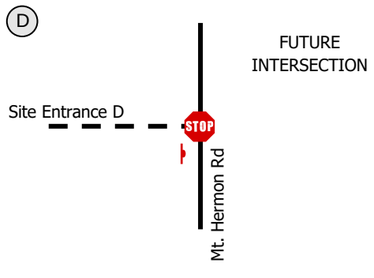


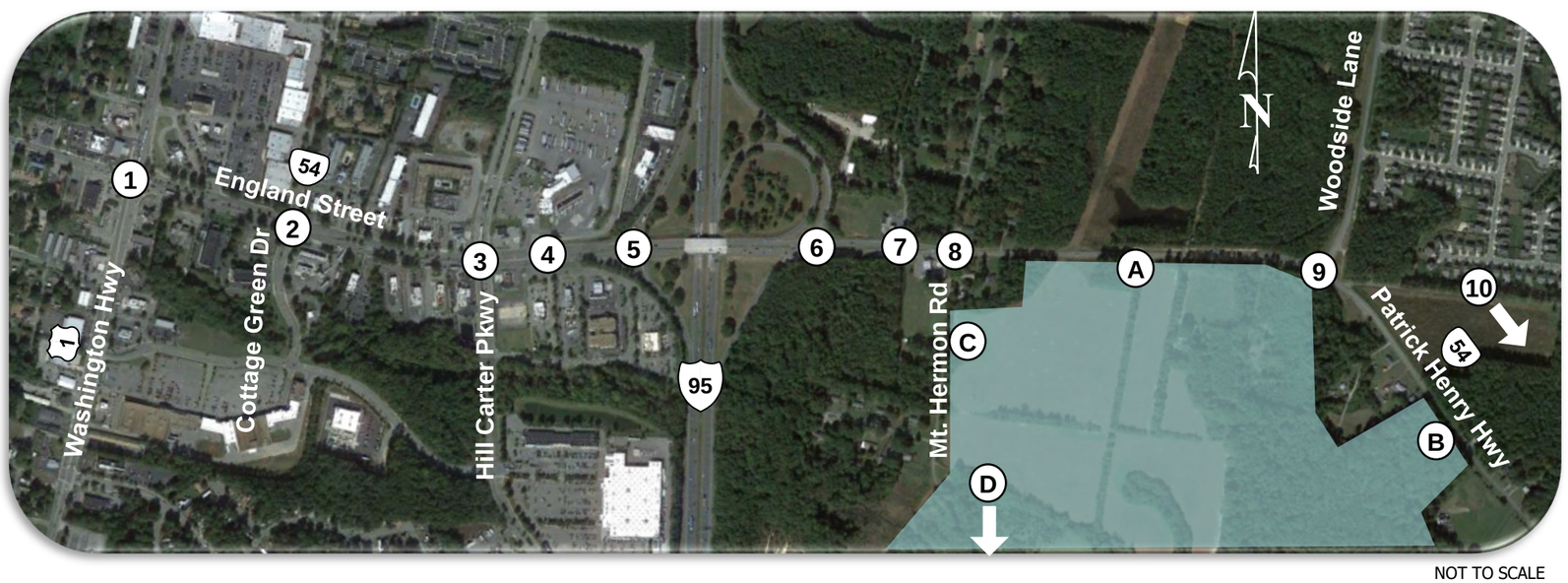
LEGEND:

———	Existing Road
- - - -	Proposed Road
S'	Effective Storage Length (in feet)*
FFR	Free Flow Right
LMT	Lane Must Turn
	Signalized Intersection
STOP	Stop Controlled Intersection
	Stop Sign Location
	Lane Configuration
	Channelization
	Yield

* Per TOSAM, effective storage is the full width storage plus ½ the taper. Dual turn lanes indicated in brackets.







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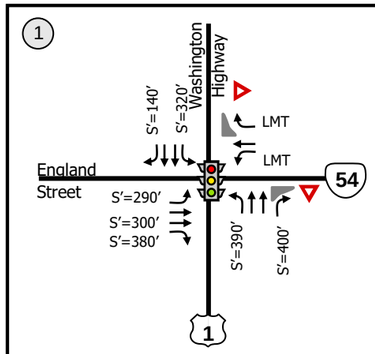
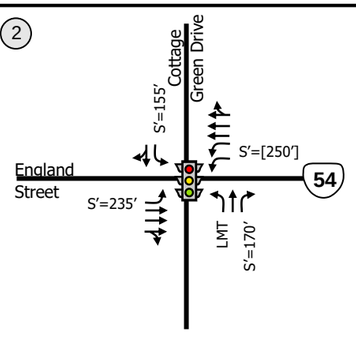
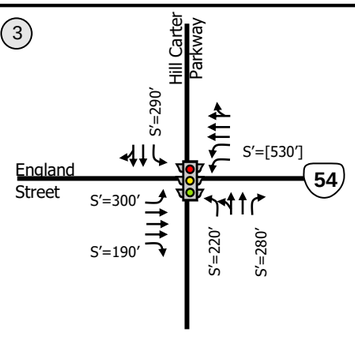
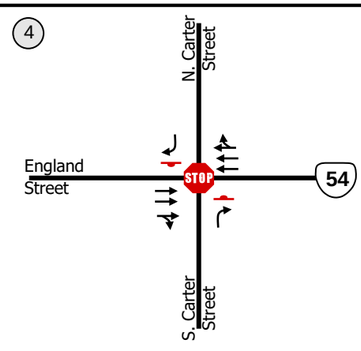
VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
Existing Intersection Geometry

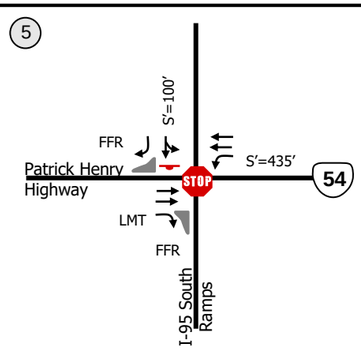
Figure
2-1

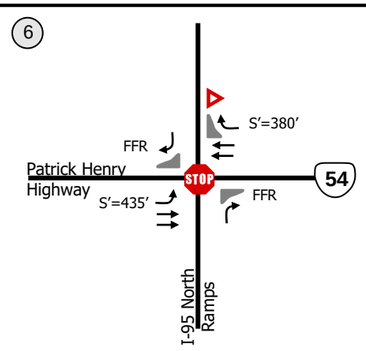


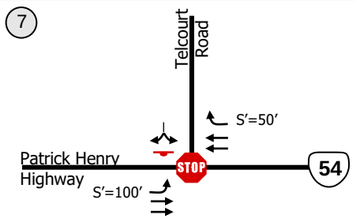


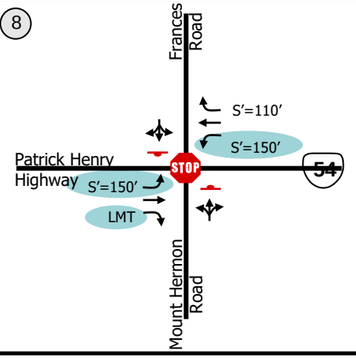


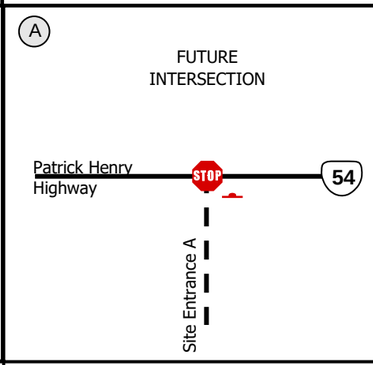


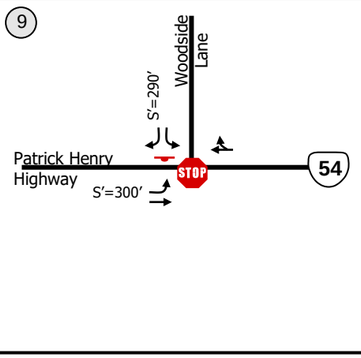


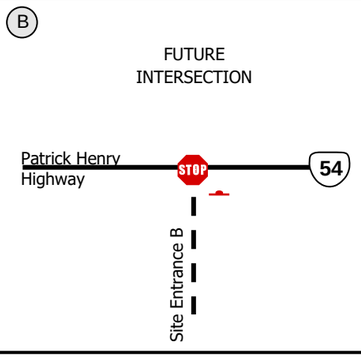


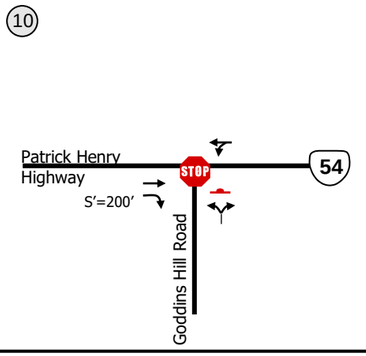








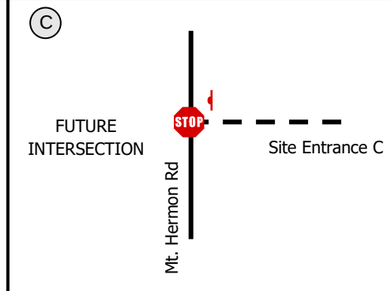


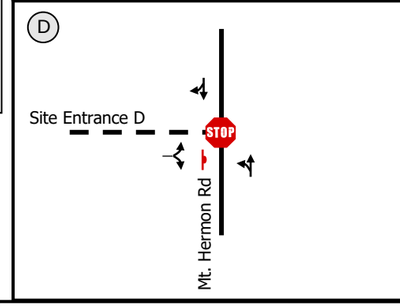


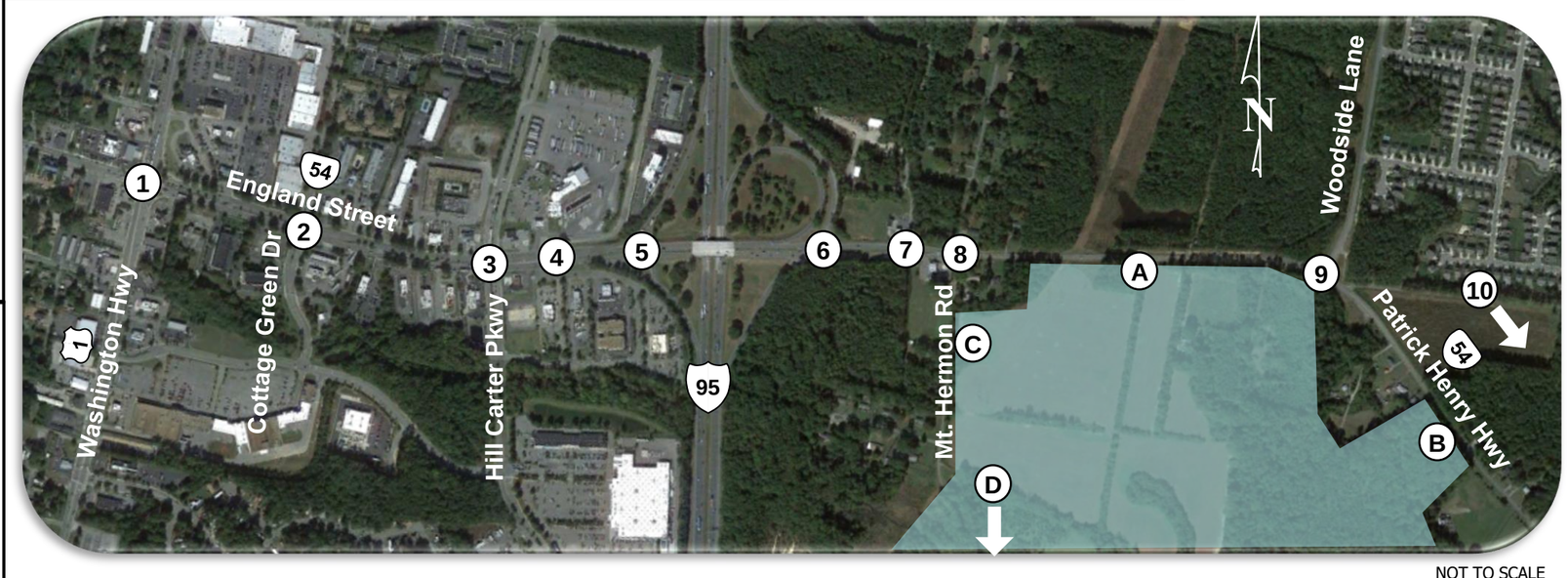
LEGEND:

- Existing Road
- Proposed Road
- S' Effective Storage Length (in feet)*
- FFR Free Flow Right
- LMT Lane Must Turn
- Signalized Intersection
- Stop Controlled Intersection
- Stop Sign Location
- Lane Configuration
- Channelization
- Yield
- Background Development Improvement

* Per TOSAM, effective storage is the full width storage plus ½ the taper. Dual turn lanes indicated in brackets.







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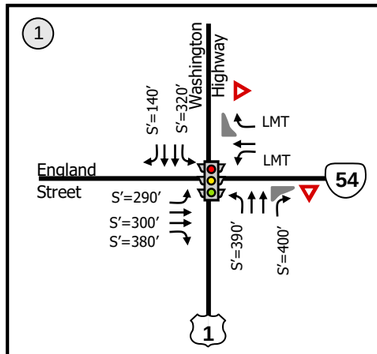
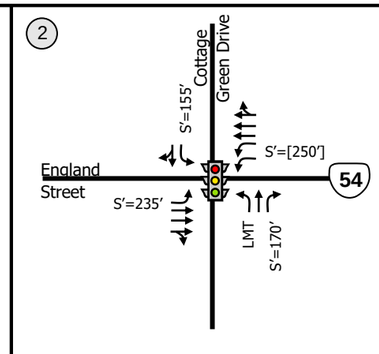
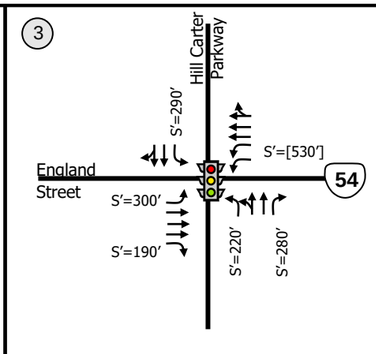
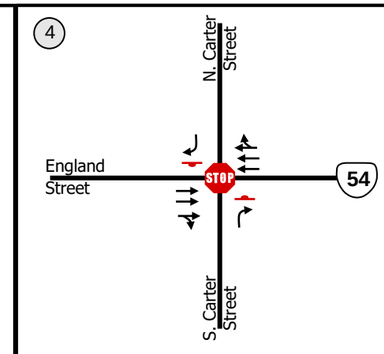
Iron Horse Business Center Rezoning
Phase 1 Intersection Geometry

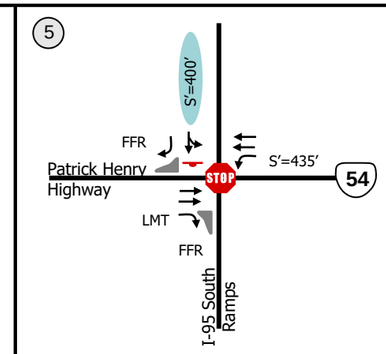
Figure 2-2

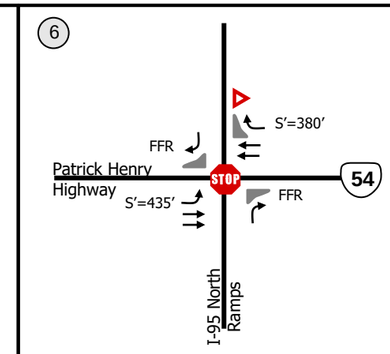


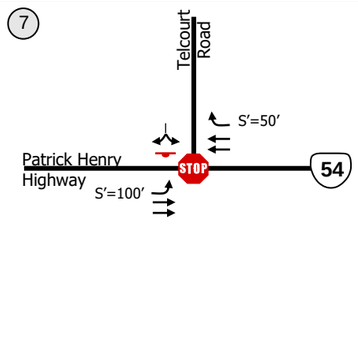


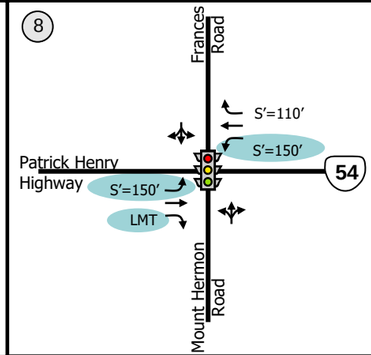


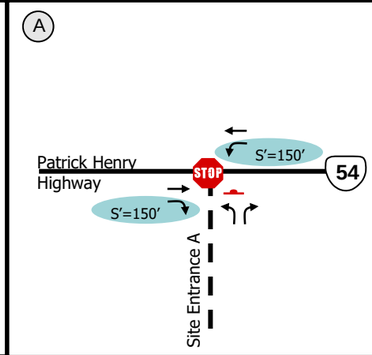


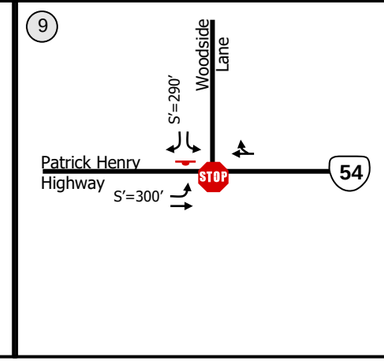


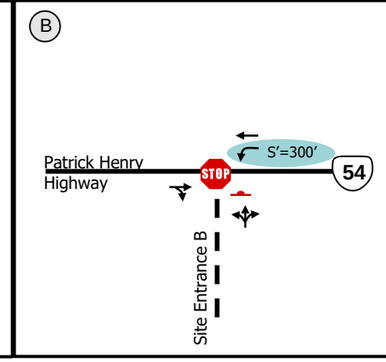


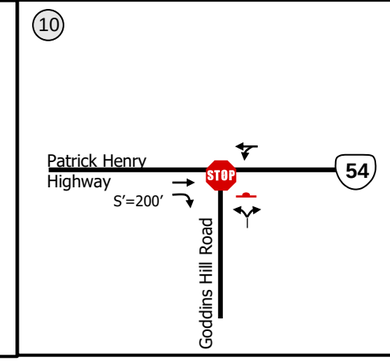












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- Lane Configuration
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- Proposed Development Improvement

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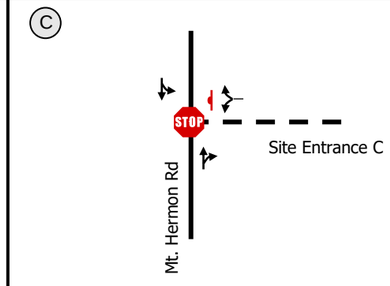

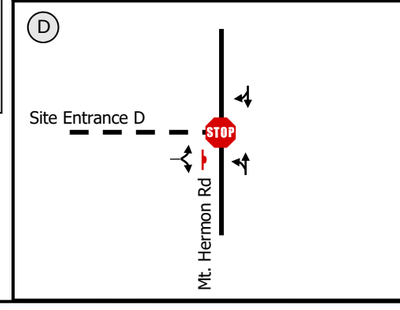

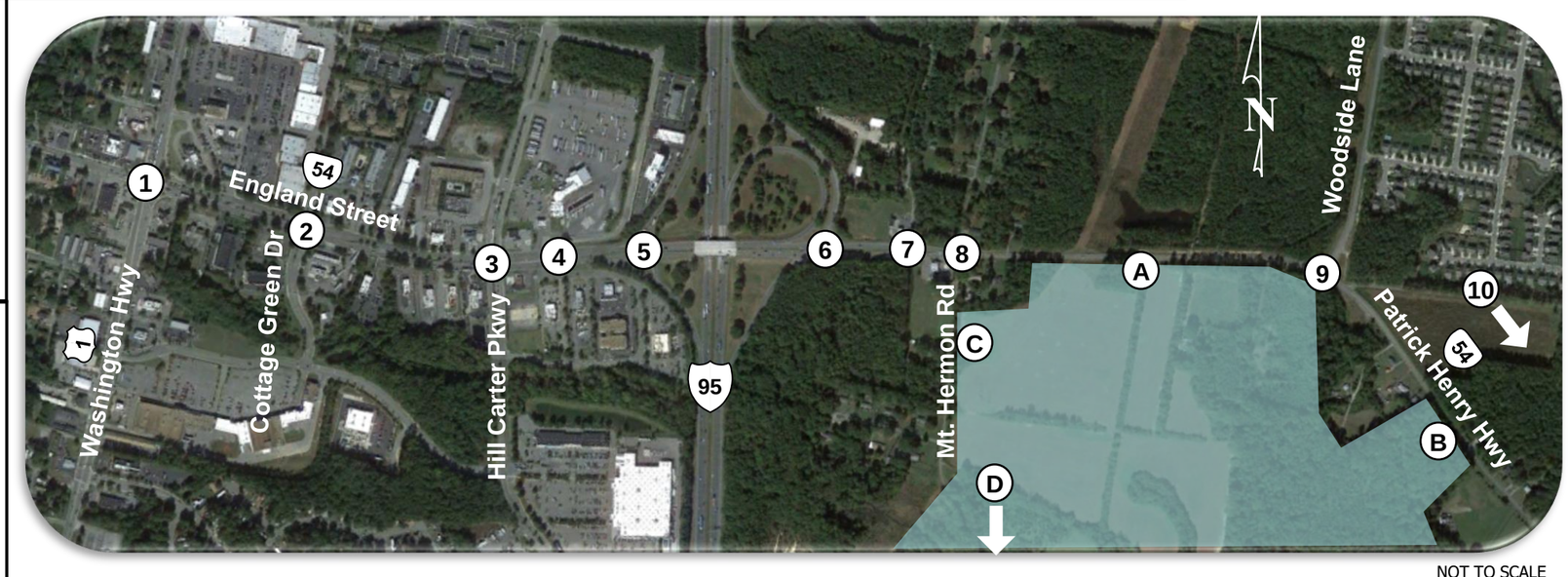

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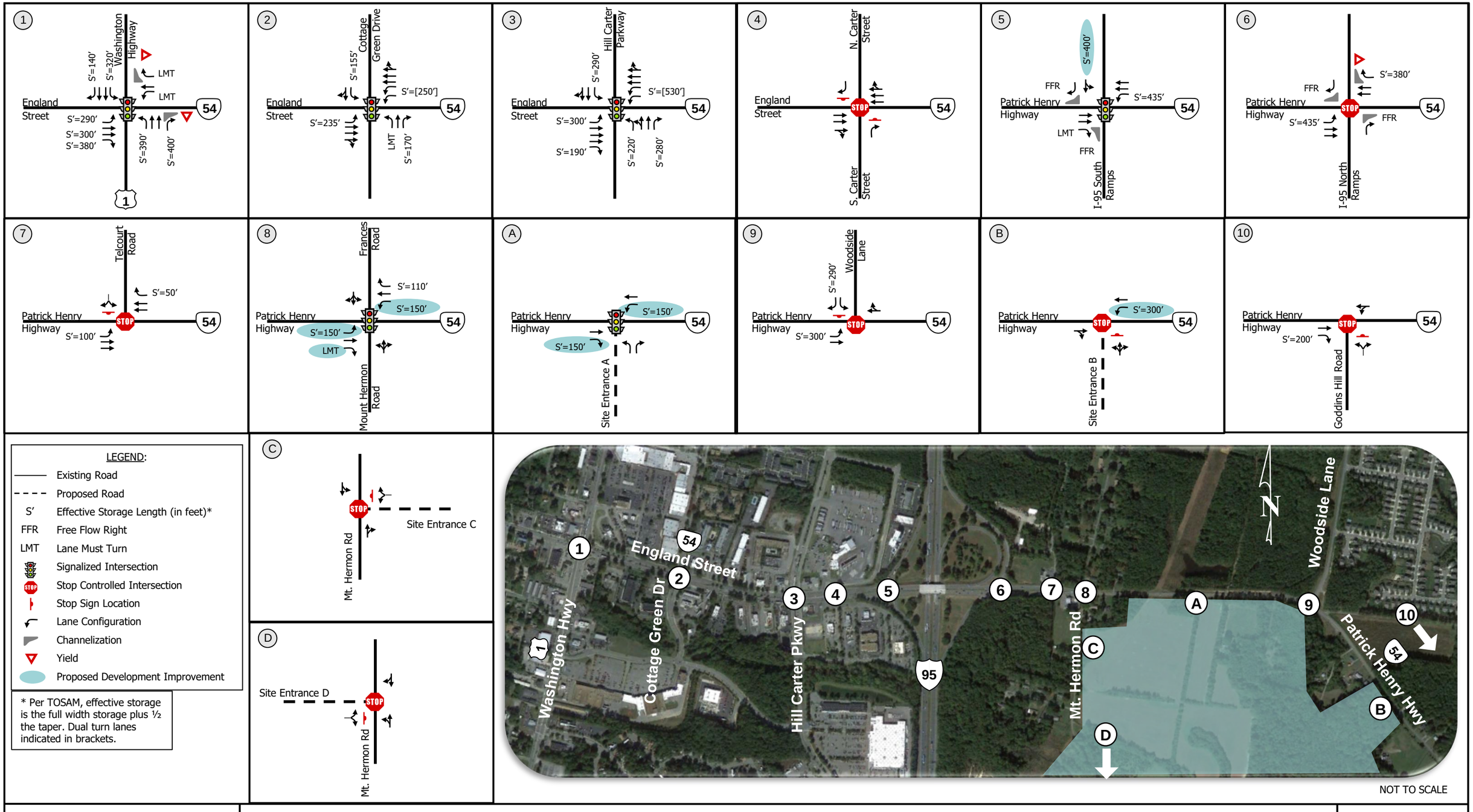
Iron Horse Business Center Rezoning
Phase 2 Intersection Geometry

Figure
2-3



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VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
Phase 3 Intersection Geometry

Figure
2-4

3 2022 EXISTING CONDITIONS

3.1 EXISTING TRAFFIC VOLUMES

Existing peak hour turning movement counts (TMC) were conducted at each of the ten (10) study intersections during the AM (7:00-9:00) and PM (4:00-6:00) peak hour timeframes. The counts were conducted on May 5, 2022 on a typical weekday when public schools were in session. In addition, 12-hour TMCs were collected at the intersection of Route 54 and Mt. Hermon Road. The counts included heavy vehicles by movement, pedestrians, and bikes.

The 2022 TMCs were compared to the 2019 VDOT Traffic Data (AADT) to determine the impact COVID-19 may have had on the traffic patterns within the study area. The 2019 data was selected to provide a more conservative comparison because the 2021 data is lower and traffic patterns had not returned to pre-COVID levels in 2021. As shown in Table 3-1, there were 25,000 vehicles per day on Route 54 between US Route 1 and I-95 with a K-Factor of 0.096 and Directional Factor of 0.566. The AADT was multiplied by the K- and Directional Factors to find the estimated peak hour traffic volumes.

Table 3-1: 2019 VDOT Traffic Data
Route 54 between US Route 1 and I-95

VDOT 2019 AADT	Hourly Volume (higher direction)	Hourly Volume (lower direction)
25,000	1358	1042

The 2022 peak hour traffic volumes on mainline Route 54 were compared to the estimated peak hour volumes calculated from the 2019 VDOT AADT in the same location. As shown in Table 3-2, the 2022 traffic volumes are within 80% - 99% of the pre-COVID traffic volumes in 2019. Therefore, it was found that traffic volumes have returned to similar pre-pandemic levels and the 2022 TMCs were not adjusted.

Table 3-2: Traffic Data Comparison
Route 54 between US Route 1 and I-95

Direction		2022 Traffic Data (vph)	Departure From AADT Hourly Volume
Eastbound	AM	924	89%
	PM	1239	91%
Westbound	AM	1027	99%
	PM	1091	80%

The raw traffic counts are included in Appendix B and the existing peak hour counts shown on Figure 3-1. The common peak hours for all study intersections were found to be 7:30-8:30 AM and 4:30-5:30 PM.

Existing signal timings for all intersections were provided by VDOT and are included in Appendix C.

3.2 CAPACITY ANALYSES

Capacity analysis allows traffic engineers to determine the impacts of traffic on the surrounding roadway network. The Highway Capacity Manual methodologies govern how the capacity analyses are conducted and how the results are interpreted. Levels of service (LOS) are determined for each part of the roadway network, with LOS A through D representing acceptable results and LOS E and F representing unacceptable results. Table 3-3 shows in detail how each of these levels of service are interpreted.

Capacity analyses were performed to assess existing (2022), background (2027/2032/2038), and total future (2027/2032/2038) operational conditions for the AM and PM peak hours of the study area. The signalized and unsignalized intersections were analyzed using SYNCHRO Version 11 based on HCM 2000 methodologies with the following assumptions:

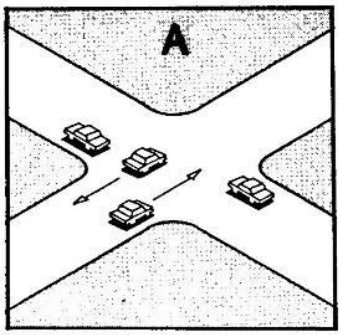
- Level terrain;
- 12-foot lane widths;
- No parking activity or bus stops;
- Existing peak hour factor as determined by traffic counts (by intersection) for existing scenario;
- The higher of the existing peak hour factor as determined by traffic counts (by intersection) or a peak hour factor of 0.92; and
- Heavy vehicle percentage as determined by the traffic counts (by movement). Note that heavy vehicle percentages were recalculated in each of the total future analysis scenarios to correctly reflect the addition of trucks to the roadway network associated with the proposed industrial portion of the development.

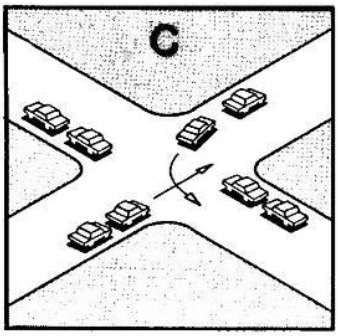
HCM 2000 methodologies were utilized for analysis as opposed to the latest HCM Sixth Edition or HCM 2010 methodologies. This selection is due to the non-standard NEMA phasing that is present at the some of the study intersections. The HCM Sixth Edition methodology only provides measures of effectiveness for signalized intersections following strict NEMA phasing.

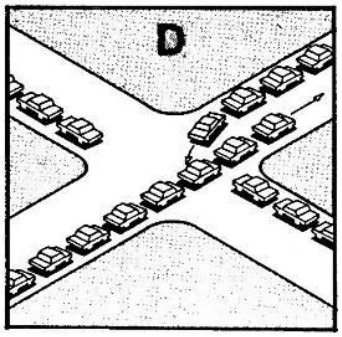
The study area 2022 Existing SYNCHRO models were calibrated to meet TOSAM methodologies for average speed using the VDOT Sample Size Determination Tool Version 2.0. The results worksheets are included in Appendix D.

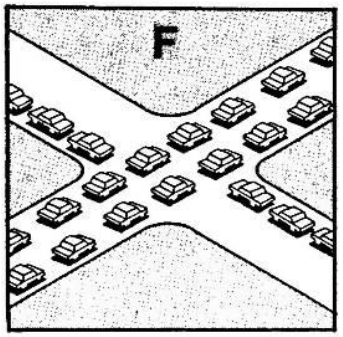
Table 3-3: Level of Service Definitions

Level of Service	Roadway Segments or Controlled Access Highways	Intersections
A	Free flow, low traffic density.	No vehicle waits longer than one signal indication.
B	Delay is not unreasonable, stable traffic flow.	On a rare occasion motorists wait through more than one signal indication.
C	Stable condition, movements somewhat restricted due to higher volumes, but not objectionable for motorists.	Intermittently drivers wait through more than one signal indication, and occasionally backups may develop behind left turning vehicles, traffic flow still stable and acceptable.
D	Movements more restricted, queues and delays may occur during short peaks, but lower demands occur often enough to permit clearing, thus preventing excessive backups.	Delays at intersections may become extensive with some, especially left-turning vehicles waiting two or more signal indications, but enough cycles with lower demand occur to permit periodic clearance, thus preventing excessive backups.
E	Actual capacity of the roadway invloves delay to all motorists due to congestion.	Very long queues may create lengthly delays, especially for left-turning vehicles.
F	Forced flow with demand volumes greater than capacity resulting in complete congestion. Volumes drop to zero in extreme cases.	Backups from locations downstream restrict or prevent movement of vehicles out of approach creating a storage ares during part or all of an hour.









SOURCE: *"A Policy on Design of Design of Urban Highways and Arterial Streets"* - AASHTO, 1973 based upon material published in *"Highway Capacity Manual"*, National Academy of Sciences, 1965.

For both unsignalized and signalized intersections, level of service is defined in terms of delay, a measure of driver discomfort, frustration, fuel consumption and lost travel time. Table 3-4 summarizes the delay associated with each LOS category:

Table 3-4: Unsignalized and Signalized Intersection Level of Service Criteria

Unsignalized Intersections		Signalized Intersections	
Level of Service	Delay per Vehicle (sec)	Level of Service	Delay per Vehicle (sec)
A	≤10.0	A	≤ 10.0
B	>10.0 to ≤15.0	B	>10.0 To ≤20.0
C	>15.0 to ≤25.0	C	>20.1 to ≤35.0
D	>25.0 to ≤35.0	D	>35.1 to ≤55.0
E	>35.0 to ≤50.0	E	>55.1 to ≤80.0
F	>50.0	F	> 80.1

Queuing analysis allows traffic engineers to identify where vehicles queues are not adequately accommodated by existing storage bays and impact adjacent travel lanes.

Queuing analyses were conducted using both the HCM 2000 methodology (as calculated by SYNCHRO) and SimTraffic simulations. The Synchro 95th percentile queue is the maximum back of queue for a particular lane within a lane group considering 95th percentile traffic volumes. The SimTraffic maximum queues are the average maximum queues after 10 runs of 60 minutes each.

Note that it is possible for the 95th percentile queue to be higher than the SimTraffic maximum queue due to the method in which each software calculates its respective value. The 95th percentile queue is based on an HCM formula while the SimTraffic maximum queue varies based on simulation results.

3.3 2022 EXISTING CONDITIONS ANALYSIS

Table 3-3 summarizes the 2022 existing intersection LOS, delay, 95th percentile (Synchro and SIDRA), and maximum (SimTraffic) queue lengths based on the 2022 existing peak hour traffic volumes shown on Figure 3-1, the existing lane geometry (Figure 2-1), and the existing timings at the traffic signals. The corresponding SYNCHRO and SIDRA worksheets are included in Appendix E.

Note at Intersection #3 that the eastbound right movement is reporting excessive delay. This is an error with how Synchro is reporting delay for the intersection and may be caused by the pedestrian phase associated with the eastbound approach being turned on all the time. However, the 95th Percentile queue length is low which shows that vehicles are not waiting for the amount of time suggested by the control delay.

Note at Intersection #6 the I-95 off-ramps (SB right and NB right) are coded in Synchro as yield controlled approaches due to the existing signs at the intersection. However, the existing lane geometry for those movements includes a receiving lane for merging traffic. As shown by the SimTraffic queue lengths (0 ft), these movements operate as free-flowing despite the HCM reports showing delay.

As shown in Table 3-5, under 2022 existing conditions:

- At the signalized intersection of Route 54 and Washington Highway, the overall intersection operates at a LOS C during both peak hours.
    - The mainline movements all operate at a LOS C or better during both peak hours. The northbound left operates at a LOS C/D during the AM/PM peaks, respectively. The NB thru operates at a LOS D/E during the AM/PM peaks, respectively. The southbound approach operates at a LOS D during both peak hours. The SB thru operates at a LOS E during the PM peak hour.
    - All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Cottage Green Drive, the overall intersection operates at a LOS B/C during the AM/PM peaks, respectively.
    - The mainline through movements operate at a LOS B or better during both peak hours. The EB and WB lefts generally operate at a LOS D/E during both peak hours. The north- and southbound movements all operate at a LOS D during the AM peak hour. During the PM peak, The NB approach operates at a LOS E and the SB approach at a LOS D.
    - During the PM peak hour, the southbound left maximum queue exceeds the available storage, spilling back into the through lane. All other movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Hill Carter Parkway, the overall intersection operates at a LOS C/D during the AM/PM peaks, respectively.
    - The eastbound left and through movements operate at a LOS D and C, respectively during both peak hours. As previously mentioned, the delay for the EB right is not reported correctly at this intersection. The westbound left and through movements operate at a LOS D and B, respectively during both peak hours.
    - The northbound approach operates at a LOS D during both peak hours. The southbound approach operates at a LOS D/E during the AM/PM peaks, respectively. All 95th percentile and maximum queue lengths are contained within the available storage.

- At the unsignalized intersection of Route 54 and I-95 SB ramp, the mainline east- and westbound approaches operate at a LOS A during both peak hours. The southbound left/through movement operates at a LOS F during both peak hours.

- At the unsignalized intersection of Route 54 and I-95 NB ramp, the mainline east- and westbound approaches operate at a LOS A during both peak hours. As previously mentioned, the north- and southbound movements report delay due to the yield-control, however the movements behave more like free-flow right turns. The northbound right operates at a LOS B or better during both peak hours. The southbound right operates at a LOS D during both peak hours. All 95th percentile and maximum queue lengths are contained within the available storage.

- At all other unsignalized intersections (numbers 4, 7-10), the mainline east- and westbound movements all operate at a LOS A during both peak hours. All side street movements operate at acceptable levels (LOS C or better) during both peak hours. All 95th percentile and maximum queue lengths are contained within the available storage.

Table 3-5: Intersection Level of Service and Delay Summary
2022 Existing Traffic

Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
1. Route 54 (E-W) at	EB Left	290	22.0	C	56	96	24.3	C	101	179
Washington Hwy (N-S)	EB Thru		31.1	C	160	208	33.9	C	196	265
Signalized	EB Right	300	27.5	C	0	79	29.9	C	0	113
	EB Approach		*29.1*	*C*	--	--	*31.3*	*C*	--	--
	WB Left		12.8	B	23	179	20.0	B	90	258
	WB Thru		25.4	C	#386	303	27.3	C	#460	514
	WB Right		0.3	A	39	0	0.2	A	0	34
	WB Approach		14.0	B	--	--	18.3	B	--	--
	NB Left	350	30.0	C	117	168	42.2	D	203	263
	NB Thru		38.2	D	95	167	56.7	E	225	243
	NB Right		0.1	A	0	0	0.2	A	0	0
	NB Approach		*25.6*	*C*	--	--	*39.0*	*D*	--	--
	SB Left	320	35.2	D	178	242	46.9	D	#226	287
	SB Thru		40.6	D	160	224	55.2	E	226	277
	SB Right	140	34.9	C	0	0	43.1	D	0	140
	SB Approach		*38.0*	*D*	--	--	*50.9*	*D*	--	--
	Overall		**25.6**	**C**	--	--	**34.6**	**C**	--	--
2. Route 54 (E-W) at	EB Left	235	72.8	E	m15	54	45.1	D	m45	78
Cottage Green Dr (N-S)	EB Thru - Right		19.1	B	149	213	15.7	B	132	231
Signalized	*EB Approach*		*20.0*	*B*	--	--	*16.8*	*B*	--	--
	WB Dual Left	260	78.2	E	32	65	*70.5*	E	47	170
	WB Thru - Right		2.4	A	38	154	*11.0*	B	75	260
	WB Approach		*5.6*	*A*	--	--	*14.8*	*B*	--	--
	NB Left		48.1	D	36	73	*56.8*	E	74	98
	NB Thru		46.0	D	13	52	56.6	E	77	108
	NB Right	170	45.6	D	0	33	53.0	D	0	65
	NB Approach		*47.0*	*D*	--	--	*55.5*	*E*	--	--
	SB Left	155	47.2	D	95	127	54.4	D	212	154
	SB Thru - Right		42.3	D	37	79	44.5	D	82	302
	SB Approach		*45.7*	*D*	--	--	*51.6*	*D*	--	--
	Overall		**15.0**	**B**	--	--	**22.8**	**C**	--	--
3. Route 54 (E-W) at	EB Left	325	41.5	D	m48	107	44.0	D	m82	106
Hill Carter Pkwy (N-S)	EB Thru		31.6	C	205	338	26.0	C	276	480
Signalized	EB Right	190	22.5	C	33	189	288.1	F	m84	190
	EB Approach		*31.1*	*C*	--	--	*61.9*	*E*	--	--
	WB Dual Left	550	38.8	D	90	126	*48.6*	D	125	152
	WB Thru - Right		19.3	B	201	199	*19.9*	B	220	253
	WB Approach		*22.9*	*C*	--	--	*26.0*	*C*	--	--
	NB Left	220	43.6	D	58	44	*53.8*	D	132	144
	NB Left - Thru		42.6	D	32	96	49.8	D	69	188
	NB Right	325	42.4	D	0	129	49.1	D	80	180
	NB Approach		*42.6*	*D*	--	--	*50.2*	*D*	--	--
	SB Left	290	51.9	D	91	207	*61.2*	*E*	101	171
	SB Thru - Right		40.3	D	18	62	50.8	D	23	43
	SB Approach		*48.6*	*D*	--	--	*57.5*	*E*	--	--
	Overall		**29.3**	**C**	--	--	**45.7**	**D**	--	--
4. Route 54 (E-W) at	EB Thru - Right		†	†	--	50	†	†	--	138
Carter Rd (N-S)	*EB Approach*		†	†	--	--	†	†	--	--
Unsignalized	WB Thru - Right		†	†	--	15	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		10.8	B	8	62	11.9	B	5	65
	NB Approach		*10.8*	B	--	--	*11.9*	B	--	--
	SB Right		11.3	B	2	50	10.9	B	1	27
	SB Approach		*11.3*	B	--	--	*10.9*	B	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.

Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
5. Route 54 (E-W) at	EB Thru		†	†	--	--	†	†	--	20
I-95 SB Ramps	EB Right		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left	435	8.7	A	17	78	9.2	A	16	85
	WB Thru		†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	SB Left - Thru	100	62.0	F	7	32	97.5	F	35	60
	SB Right		18.0	C	58	0	16.2	C	47	--
	SB Approach		*19.1*	C	--	--	*24.1*	C	--	--
6. Route 54 (E-W) at	EB Left	435	9.2	A	13	93	9.3	A	19	115
I-95 NB Ramps	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	4	†	†	--	4
	WB Right	380	†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		9.6	A	13	0	10.5	B	23	0
	NB Approach		*9.6*	A	--	--	*10.5*	B	--	--
	SB Right		30.1	D	252	0	29.7	D	242	0
	SB Approach		*30.1*	D	--	--	*29.7*	D	--	--
7. Route 54 (E-W) at	EB Left		8.7	A	3	63	8.6	A	2	45
Telcourt Rd (N-S)	EB Thru		†	†	--	--	†	†	--	4
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	--	†	†	--	--
	WB Right	50	†	†	--	23	†	†	--	27
	WB Approach		†	†	--	--	†	†	--	--
	SB Left - Right		11.8	B	1	33	10.3	B	3	40
	SB Approach		*11.8*	B	--	--	*10.3*	*B*	--	--
8. Route 54 (E-W) at	EB Left		8.2	A	3	37	8.2	A	1	27
Mt. Hermon Rd/Frances Rd (N-S)	EB Thru - Right		†	†	--	--	†	†	--	68
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left - Thru		0.4	A	1	57	0.3	A	1	68
	WB Right	110	†	†	--	0	†	†	--	0
	WB Approach		†	†	--	--	†	†	--	--
	NB Left-Thru-Right		19.5	C	11	64	22.3	C	21	63
	NB Approach		*19.5*	C	--	--	*22.3*	C	--	--
	SB Left-Thru-Right		11.9	B	7	44	12.0	B	5	28
	SB Approach		*11.9*	B	--	--	*12.0*	*B*	--	--
9. Route 54 (E-W) at	EB Left	300	7.9	A	4	45	8.2	A	10	66
Woodside Ln (N-S)	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru - Right		†	†	--	2	†	†	--	2
	WB Approach		†	†	--	--	†	†	--	--
	SB Left		11.8	B	16	71	12.5	B	15	54
	SB Right	290	11.8	B	16	81	12.5	B	15	68
	SB Approach		*11.8*	B	--	--	*12.5*	*B*	--	--
10. Route 54 (E-W) at	EB Thru		†	†	--	0	†	†	--	0
Goddins Hill Rd (N-S)	EB Right	200	†	†	--	6	†	†	--	2
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left - Thru		2.8	A	6	50	1.3	A	2	37
	WB Approach		†	†	--	--	†	†	--	--
	NB Left - Right		12.4	B	9	51	11.8	B	14	52
	NB Approach		*12.4*	B	--	--	*11.8*	*B*	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.

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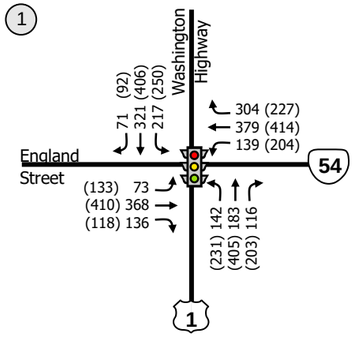
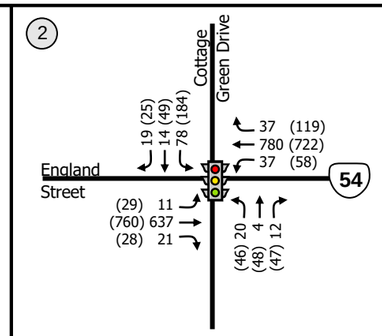
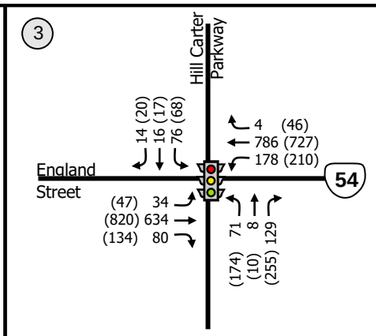
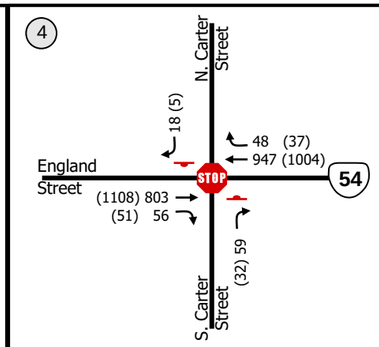
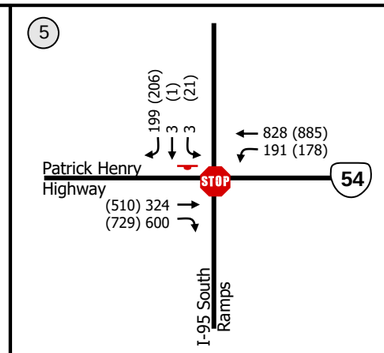
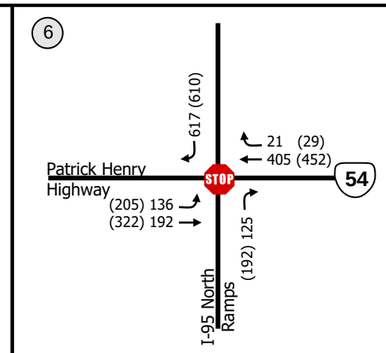


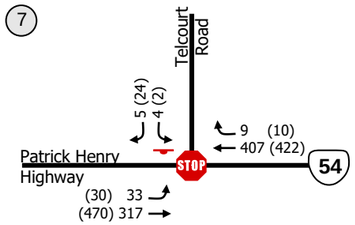


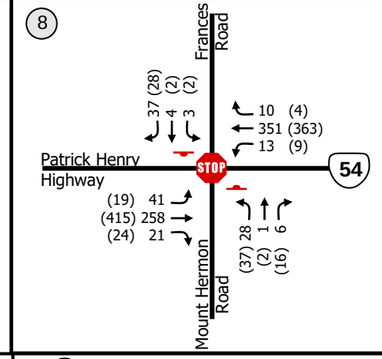


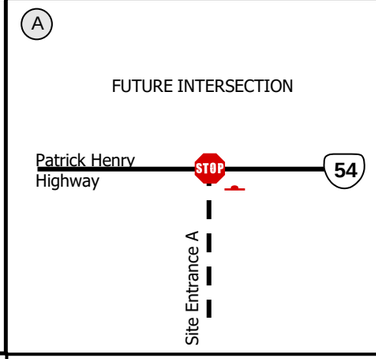


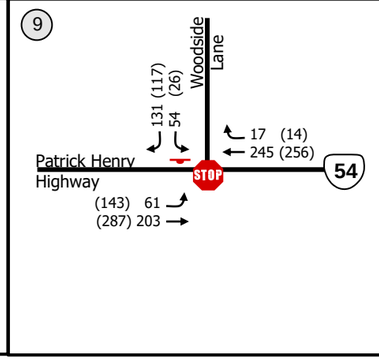


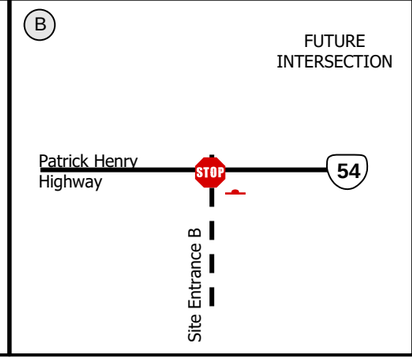


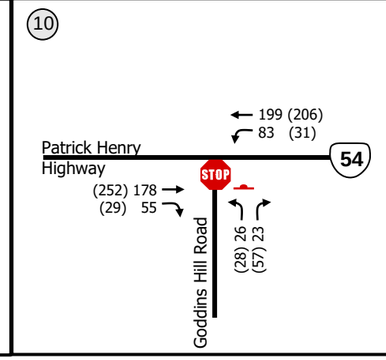






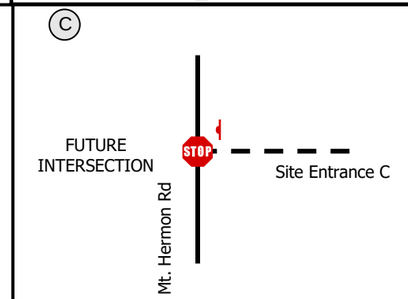


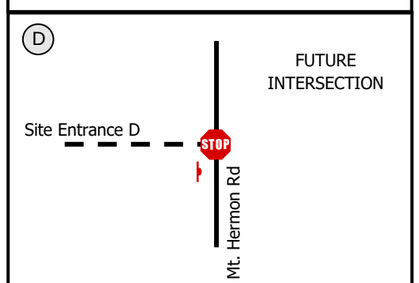


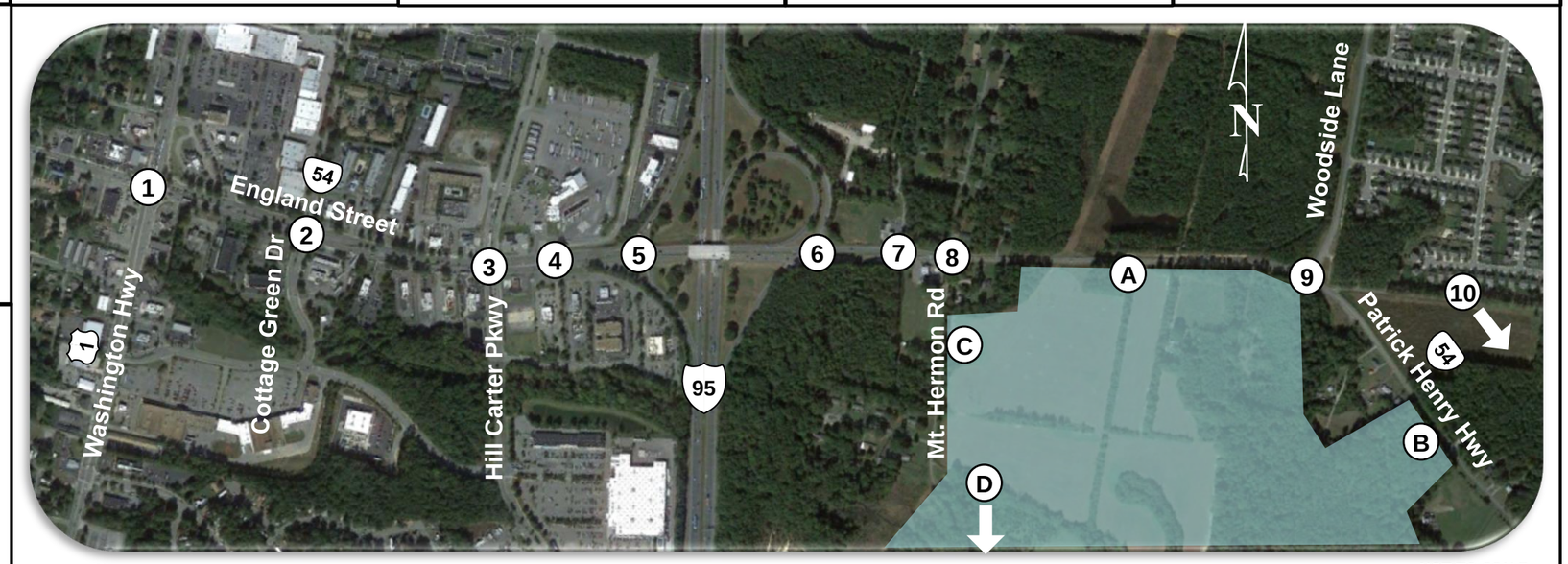


LEGEND:

- Existing Road
- Proposed Road
- XX AM Traffic Volume
- (XX) PM Traffic Volume
- Signalized Intersection
- Stop Controlled Intersection







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TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
2022 Existing Traffic Volumes

Figure
3-1

4 APPROVED BACKGROUND DEVELOPMENTS

Background developments in the study were based on coordination with VDOT, Town of Ashland, and Hanover County staff. The most recent aerial imagery (updated October 2021) was used to identify which developments had already been built.

One background development was identified within the project vicinity, Hickory Grove, and was analyzed with the August 2022 edition of this report. Since then, VDOT and Hanover County have confirmed that the development was not approved. As a result, the projected site traffic and roadway improvements associated with Hickory Grove have been removed from this report.

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5 2027 BACKGROUND CONDITIONS

The background 2027 volumes were analyzed assuming future intersection geometry in conjunction with projected background traffic volumes. The background traffic volumes were developed based on a 1.5% annual growth rate.

5.1 BACKGROUND FORECASTING METHODOLOGY

The 1.5% annual growth rate discussed above was compounded annually for the 5-year period from 2022 to 2027 and applied to the existing traffic volumes. The resulting 2027 Background Traffic Volumes are shown on Figure 5-1.

5.2 BACKGROUND 2027 CAPACITY ANALYSES

Table 5-1 summarizes the 2027 background intersection LOS, delay, 95th percentile (Synchro and SIDRA), and maximum (SimTraffic) queue lengths based on the 2027 background peak hour traffic volumes shown on Figure 5-1, the existing conditions lane geometry (Figure 2-1), and the existing timings at the traffic signals. Note that intersections A-D are shown as numbers 11-14 in the following analysis. The corresponding SYNCHRO and SIDRA worksheets are included in Appendix F.

Note at Intersection #3 that the eastbound right movement is reporting excessive delay. This is an error with how Synchro is reporting delay for the intersection and may be caused by the pedestrian phase associated with the eastbound approach being turned on all the time. However, the 95th Percentile queue length is low which shows that vehicles are not waiting for the amount of time suggested by the control delay.

Note at Intersection #6 the I-95 off-ramps (SB right and NB right) are coded in Synchro as yield controlled approaches due to the existing signs at the intersection. However, the existing lane geometry for those movements includes a receiving lane for merging traffic. As shown by the SimTraffic queue lengths (0 ft), these movements operate as free-flowing despite the HCM reports showing delay.

As shown in Table 5-1 under 2027 background conditions:

- At the signalized intersection of Route 54 and Washington Highway, the overall intersection will operate at a LOS C/D during the AM/PM peaks, respectively.
    - The eastbound approach will operate at a LOS C during both peak hours. The EB through will operate at a LOS C/D during the AM/PM peaks, respectively. The westbound approach will operate at a LOS B/C during the AM/PM peaks, respectively. The WB through will operate at a LOS C during both peak hours
    - The northbound approach and left movement will operate at a LOS C/D during the AM/PM peaks, respectively. The NB through will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound through will operate at a LOS D/E during the AM/PM peaks, respectively. The SB left will operate at a LOS D during both peak hours.
    - All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Cottage Green Drive, the overall intersection will operate at a LOS B/C during the AM/PM peaks, respectively.
    - The mainline through movements will operate at a LOS B or better during both peak hours. The EB left will operate at a LOS E/D during the AM/PM peaks, respectively. The WB left will operate at a LOS E during both peak hours.
    - The northbound approach will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach will operate at a LOS D during both peak hours. During the PM peak, the SB left maximum queue exceeds the available storage, spiling back into the through lane.
    - All other movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Hill Carter Parkway, the overall intersection will operate at a LOS C/D during the AM/PM peaks, respectively.
    - The mainline through movements will operate at a LOS C or better during both peak hours. The EB and WB lefts will operate at a LOS D during both peak hours. As previously mentioned, the delay for the EB right is not reported correctly at this intersection.
    - The northbound approach will operate at a LOS D during both peak hours. The NB left will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach will operate at a LOS D/E during the AM/PM peaks, respectively. The SB left will operate at a LOS E during both peak hours.
    - All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the unsignalized intersection of Route 54 and I-95 SB ramp, the mainline east- and westbound approaches operate at a LOS A during both peak hours. The southbound left/through movement operates at a LOS F during both peak hours. All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the unsignalized intersection of Route 54 and I-95 NB ramp, the mainline east- and westbound approaches operate at a LOS A during both peak hours. As previously mentioned, the north- and southbound movements report delay due to the yield-control, however the movements behave more like free-flow right turns. The NB right operates at a LOS B or better during both peak hours. The SB right operates at a LOS E during both peak hours. All 95th percentile and maximum queue lengths are contained within the available storage.

- At the unsignalized intersection of Route 54 and Mt. Hermon Road/Frances Road, the mainline east- and westbound movements will operate at a LOS A during both peak hours. The northbound approach will operate at a LOS C during both peak hours. The southbound approach will operate at a LOS B during both peak hours. All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At all other the unsignalized intersections (numbers 4, 7, 9-10), the mainline east- and westbound movements all operate at a LOS A during both peak hours. All side street movements operate at acceptable levels (LOS B or better) during both peak hours. All 95th percentile and maximum queue lengths are contained within the available storage.

Table 5-1: Intersection Level of Service and Delay Summary
2027 Background Peak Hour Traffic

Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
1. Route 54 (E-W) at	EB Left	290	22.5	C	59	121	26.1	C	108	192
Washington Hwy (N-S)	EB Thru		31.7	C	171	208	35.6	D	211	282
Signalized	EB Right	300	27.7	C	2	104	30.9	C	2	109
	EB Approach		*29.6*	*C*	--	--	*32.9*	*C*	--	--
	WB Left		15.3	B	41	174	26.2	C	151	317
	WB Thru		28.9	C	#421	406	33.1	C	#519	490
	WB Right		0.4	A	43	0	0.2	A	0	50
	WB Approach		16.1	B	--	--	22.6	C	--	--
	NB Left	350	30.4	C	124	173	45.4	D	#226	302
	NB Thru		38.3	D	101	157	59.6	E	#247	264
	NB Right	400	0.1	A	0	0	0.2	A	0	0
	NB Approach		*25.7*	*C*	--	--	*41.3*	*D*	--	--
	SB Left	320	37.6	D	#193	251	52.1	D	#274	282
	SB Thru		41.9	D	170	222	57.3	E	#255	273
	SB Right	140	35.0	C	0	133	42.7	D	0	140
	SB Approach		*39.6*	*D*	--	--	*53.8*	*D*	--	--
	Overall		**26.8**	**C**	--	--	**37.4**	**D**	--	--
2. Route 54 (E-W) at	EB Left	235	76.1	E	m14	50	45.5	D	m47	87
Cottage Green Dr (N-S)	EB Thru - Right		18.3	B	148	244	16.8	B	141	313
Signalized	*EB Approach*		*19.3*	*B*	--	--	*17.8*	*B*	--	--
	WB Dual Left	260	78.3	E	34	63	*70.6*	E	m43	148
	WB Thru - Right		2.4	A	39	178	*11.6*	B	80	266
	WB Approach		*5.7*	*A*	--	--	*15.4*	*B*	--	--
	NB Left		48.2	D	39	80	*56.9*	E	79	101
	NB Thru		45.9	D	13	51	56.7	E	81	99
	NB Right	170	45.5	D	0	43	52.8	D	0	64
	NB Approach		*47.1*	*D*	--	--	*55.5*	*E*	--	--
	SB Left	155	47.7	D	100	135	52.3	D	222	154
	SB Thru - Right		42.0	D	38	102	43.2	D	87	328
	SB Approach		*46.0*	*D*	--	--	*49.7*	*D*	--	--
	Overall		**14.7**	**B**	--	--	**23.2**	**C**	--	--
3. Route 54 (E-W) at	EB Left	325	39.2	D	m52	125	44.2	D	m86	118
Hill Carter Pkwy (N-S)	EB Thru		31.6	C	221	360	27.8	C	301	503
Signalized	EB Right	190	22.8	C	32	190	196.3	F	m99	190
	EB Approach		*31.0*	*C*	--	--	*51.1*	*D*	--	--
	WB Dual Left	550	38.5	D	95	121	*48.9*	D	132	151
	WB Thru - Right		19.8	B	214	213	*20.9*	C	233	250
	WB Approach		*23.2*	*C*	--	--	*26.9*	*C*	--	--
	NB Left	220	43.8	D	61	62	*55.2*	E	146	135
	NB Left - Thru		42.7	D	35	111	49.9	D	76	164
	NB Right	325	42.4	D	0	138	49.1	D	86	209
	NB Approach		*42.7*	*D*	--	--	*50.5*	*D*	--	--
	SB Left	290	56.5	E	99	228	*64.7*	*E*	107	194
	SB Thru - Right		40.4	D	19	66	50.1	D	24	50
	SB Approach		*51.9*	*D*	--	--	*59.5*	*E*	--	--
	Overall		**29.6**	**C**	--	--	**41.9**	**D**	--	--
4. Route 54 (E-W) at	EB Thru - Right		†	†	--	71	†	†	--	129
Carter Rd (N-S)	*EB Approach*		†	†	--	--	†	†	--	--
Unsignalized	WB Thru - Right		†	†	--	10	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		11.1	B	9	74	12.3	B	6	74
	NB Approach		*11.1*	B	--	--	*12.3*	B	--	--
	SB Right		11.4	B	3	58	11.1	B	1	31
	SB Approach		*11.4*	B	--	--	*11.1*	B	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.

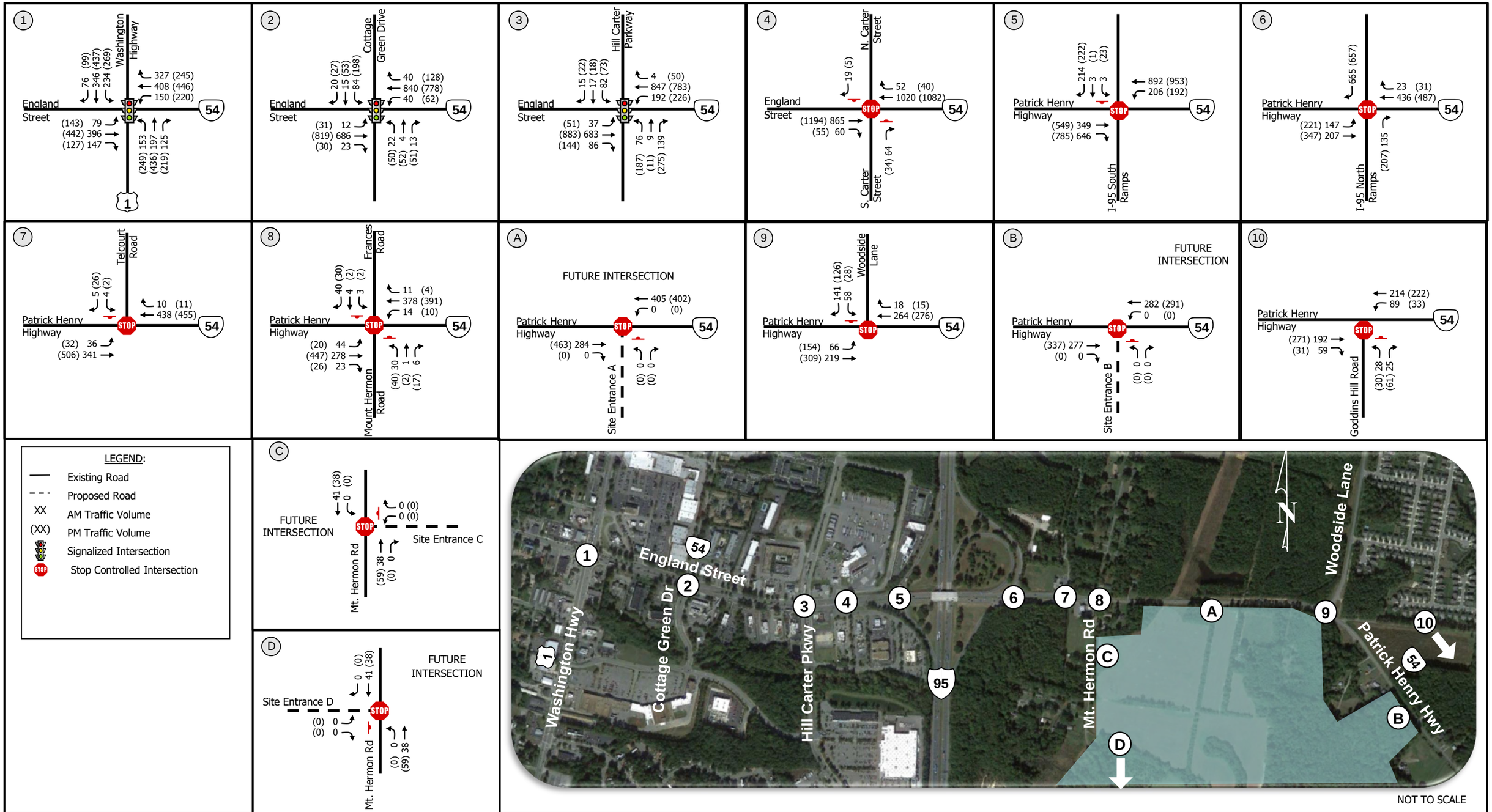
Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
5. Route 54 (E-W) at	EB Thru		†	†	--	--	†	†	--	--
I-95 SB Ramps	EB Right		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left	435	8.8	A	18	80	9.5	A	18	91
	WB Thru		†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	SB Left - Thru	150	67.8	F	8	28	143.2	F	49	79
	SB Right		18.8	C	63	0	17.9	C	58	0
	SB Approach		*20.1*	C	--	--	*30.2*	D	--	--
6. Route 54 (E-W) at	EB Left	435	9.4	A	14	98	9.6	A	22	128
I-95 NB Ramps	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	4	†	†	--	10
	WB Right	380	†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		9.8	A	14	0	10.8	B	26	0
	NB Approach		*9.8*	A	--	--	*10.8*	B	--	--
	SB Right		43.3	E	343	0	42.5	E	330	0
	SB Approach		*43.3*	E	--	--	*42.5*	E	--	--
7. Route 54 (E-W) at	EB Left		8.9	A	3	68	8.7	A	3	54
Telcourt Rd (N-S)	EB Thru		†	†	--	--	†	†	--	0
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	2	†	†	--	--
	WB Right	50	†	†	--	28	†	†	--	29
	WB Approach		†	†	--	--	†	†	--	--
	SB Left - Right		12.2	B	1	31	10.5	B	3	37
	SB Approach		*12.2*	B	--	--	*10.5*	*B*	--	--
8. Route 54 (E-W) at	EB Left		8.3	A	3	45	8.2	A	1	26
Mt. Hermon Rd/Frances Rd (N-S)	EB Thru - Right		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left - Thru		0.4	A	1	43	0.3	A	1	47
	WB Right	110	†	†	--	--	†	†	--	--
	WB Approach		0.4	A	--	--	†	†	--	--
	NB Left-Thru-Right		21.9	C	14	66	24.7	C	25	64
	NB Approach		*21.9*	C	--	--	*24.7*	C	--	--
	SB Left-Thru-Right		12.3	B	8	46	12.3	B	6	38
	SB Approach		*12.3*	B	--	--	*12.3*	*B*	--	--
9. Route 54 (E-W) at	EB Left	300	8.0	A	4	47	8.3	A	11	63
Woodside Ln (N-S)	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru - Right		†	†	--	--	†	†	--	3
	WB Approach		†	†	--	--	†	†	--	--
	SB Left		12.2	B	18	73	13.1	B	17	64
	SB Right	290	12.2	B	18	71	13.1	B	17	77
	SB Approach		*12.2*	B	--	--	*13.1*	*B*	--	--
10. Route 54 (E-W) at	EB Thru		†	†	--	--	†	†	--	--
Goddins Hill Rd (N-S)	EB Right	200	†	†	--	2	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left - Thru		2.8	A	6	66	1.3	A	2	48
	WB Approach		*2.8*	A	--	--	*1.3*	*A*	--	--
	NB Left - Right		12.6	B	9	61	12.0	B	14	52
	NB Approach		*12.6*	B	--	--	*12.0*	*B*	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.



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VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
2027 Background Traffic Volumes

Figure
5-1

6 2032 BACKGROUND CONDITIONS

The background 2032 volumes were analyzed assuming future intersection geometry in conjunction with projected background traffic volumes. The background traffic volumes were developed based on a 1.5% annual growth rate and the completion of one (1) other development in the study area.

6.1 BACKGROUND FORECASTING METHODOLOGY

The 1.5% annual growth rate discussed above was compounded annually for the 9-year period from 2022 to 2032 and applied to the existing traffic volumes. The resulting 2032 Background Traffic Volumes are shown on Figure 6-1.

6.2 BACKGROUND 2032 CAPACITY ANALYSES

Table 6-1 summarizes the 2032 background intersection LOS, delay, 95th percentile (Synchro and SIDRA), and maximum (SimTraffic) queue lengths based on the 2032 background peak hour traffic volumes shown on Figure 6-1, the existing conditions lane geometry (Figure 2-1), and the existing timings at the traffic signals. Note that intersections A-D are shown as numbers 11-14 in the following analysis. The corresponding SYNCHRO and SIDRA worksheets are included in Appendix G.

Note at Intersection #3 that the eastbound right movement is reporting excessive delay. This is an error with how Synchro is reporting delay for the intersection and may be caused by the pedestrian phase associated with the eastbound approach being turned on all the time. However, the 95th Percentile queue length is low which shows that vehicles are not waiting for the amount of time suggested by the control delay.

Note at Intersection #6 the I-95 off-ramps (SB right and NB right) are coded in Synchro as yield controlled approaches due to the existing signs at the intersection. However, the existing lane geometry for those movements includes a receiving lane for merging traffic. As shown by the SimTraffic queue lengths (0 ft), these movements operate as free-flowing despite the HCM reports showing delay.

As shown in Table 6-1 under 2032 background conditions:

- At the signalized intersection of Route 54 and Washington Highway, the overall intersection will operate at a LOS C/D during the AM/PM peaks, respectively.
    - The eastbound approach will operate at a LOS C/D during the AM/PM peaks, respectively. The westbound approach will operate at a LOS B/C during the AM/PM peaks, respectively. The WB through will operate at a LOS D during both peak hours.
    - The northbound left movement will operate at a LOS C/E during the AM/PM peaks, respectively. The NB through will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound left and through will both operate at a LOS D/E during the AM/PM peaks, respectively.
    - All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Cottage Green Drive, the overall intersection will operate at a LOS B/C during the AM/PM peaks, respectively.
    - The mainline through movements will operate at a LOS B or better during both peak hours. The EB left will operate at a LOS E/D during the AM/PM peaks, respectively. The WB left will operate at a LOS F/E during the AM/PM peaks, respectively.
    - The northbound approach will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach will operate at a LOS D during both peak hours. During the PM peak, the SB left maximum queue exceeds the available storage, spiling back into the through lane.
    - All other movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Hill Carter Parkway, the overall intersection will operate at a LOS C/D during the AM/PM peaks, respectively.
    - The mainline through movements will operate at a LOS C during both peak hours. The EB and WB lefts will operate at a LOS D during both peak hours. As previously mentioned, the delay for the EB right is not reported correctly at this intersection.
    - The northbound approach will operate at a LOS D during both peak hours. The NB left will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach will operate at a LOS D/E during the AM/PM peaks, respectively. The SB left will operate at a LOS E during both peak hours.
    - All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the unsignalized intersection of Route 54 and I-95 SB ramp, the mainline east- and westbound approaches operate at a LOS A during both peak hours. The southbound left/through movement operates at a LOS F during both peak hours. All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the unsignalized intersection of Route 54 and I-95 NB ramp, the mainline east- and westbound approaches operate at a LOS A during both peak hours. As previously mentioned, the north- and southbound movements report delay due to the yield-control, however the movements behave more like free-flow right turns. The NB right operates at a LOS B or better during both peak hours. The SB right operates at a LOS F during both peak hours. All 95th percentile and maximum queue lengths are contained within the available storage.

- At the unsignalized intersection of Route 54 and Mt. Hermon Road/Frances Road, the mainline east- and westbound movements will operate at a LOS A during both peak hours. The northbound approach will operate at a LOS C/D during the AM/PM peaks, respectively. The southbound approach will operate at a LOS B during both peak hours. All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At all other unsignalized intersections (numbers 4, 7, 9-10), the mainline east- and westbound movements all operate at a LOS A during both peak hours. All side street movements operate at acceptable levels (LOS B or better) during both peak hours. All 95th percentile and maximum queue lengths are contained within the available storage.

Table 6-1: Intersection Level of Service and Delay Summary
2032 Background Peak Hour Traffic

Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
1. Route 54 (E-W) at	EB Left	290	23.5	C	63	127	29.9	C	115	193
Washington Hwy (N-S)	EB Thru		32.5	C	184	224	37.5	D	228	282
Signalized	EB Right	300	27.9	C	9	101	31.9	C	10	145
	EB Approach		*30.3*	*C*	--	--	*35.0*	*C*	--	--
	WB Left		17.5	B	60	218	34.7	C	198	333
	WB Thru		35.5	D	#475	440	45.7	D	#578	596
	WB Right		0.4	A	44	0	0.3	A	0	84
	WB Approach		19.5	B	--	--	30.8	C	--	--
	NB Left	350	31.5	C	133	204	58.5	E	#316	315
	NB Thru		38.5	D	107	163	63.9	E	#285	355
	NB Right	400	0.1	A	0	0	0.2	A	0	0
	NB Approach		*26.1*	*C*	--	--	*47.2*	*D*	--	--
	SB Left	320	41.0	D	#230	271	63.7	E	#332	313
	SB Thru		43.6	D	183	224	64.2	E	#288	372
	SB Right	140	35.0	C	0	140	42.9	D	0	140
	SB Approach		*41.7*	*D*	--	--	*61.4*	*E*	--	--
	Overall		**28.7**	**C**	--	--	**43.6**	**D**	--	--
2. Route 54 (E-W) at	EB Left	235	78.3	E	m13	57	47.5	D	m49	108
Cottage Green Dr (N-S)	EB Thru - Right		16.9	B	140	265	18.6	B	m164	239
Signalized	*EB Approach*		*18.0*	*B*	--	--	*19.6*	*B*	--	--
	WB Dual Left	260	80.1	F	36	93	*69.5*	E	m39	96
	WB Thru - Right		2.3	A	39	199	*13.1*	B	139	275
	WB Approach		*5.7*	*A*	--	--	*16.7*	*B*	--	--
	NB Left		48.2	D	40	77	*56.9*	E	83	108
	NB Thru		45.9	D	14	50	56.7	E	86	106
	NB Right	170	45.4	D	0	35	52.6	D	0	67
	NB Approach		*47.0*	*D*	--	--	*55.4*	*E*	--	--
	SB Left	155	48.5	D	107	140	49.5	D	237	154
	SB Thru - Right		41.7	D	40	102	41.4	D	91	308
	SB Approach		*46.5*	*D*	--	--	*47.2*	*D*	--	--
	Overall		**14.2**	**B**	--	--	**24.1**	**C**	--	--
3. Route 54 (E-W) at	EB Left	325	37.6	D	m48	115	43.9	D	m90	135
Hill Carter Pkwy (N-S)	EB Thru		30.4	C	237	439	29.3	C	324	526
Signalized	EB Right	190	22.7	C	28	190	157.8	F	m116	190
	EB Approach		*29.9*	*C*	--	--	*47.2*	*D*	--	--
	WB Dual Left	550	39.0	D	102	125	*49.6*	D	140	161
	WB Thru - Right		20.2	C	227	232	*21.7*	C	241	266
	WB Approach		*23.7*	*C*	--	--	*27.7*	*C*	--	--
	NB Left	220	44.4	D	64	75	*57.9*	E	#202	168
	NB Left - Thru		43.0	D	37	109	50.2	D	84	189
	NB Right	325	42.8	D	0	153	49.3	D	#100	205
	NB Approach		*43.1*	*D*	--	--	*51.2*	*D*	--	--
	SB Left	290	60.1	E	107	215	*67.3*	*E*	115	206
	SB Thru - Right		40.2	D	20	51	49.8	D	26	72
	SB Approach		*54.4*	*D*	--	--	*61.1*	*E*	--	--
	Overall		**29.6**	**C**	--	--	**40.9**	**D**	--	--
4. Route 54 (E-W) at	EB Thru - Right		†	†	--	92	†	†	--	103
Carter Rd (N-S)	*EB Approach*		†	†	--	--	†	†	--	--
Unsignalized	WB Thru - Right		†	†	--	6	†	†	--	3
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		11.4	B	10	82	12.8	B	6	70
	NB Approach		*11.4*	B	--	--	*12.8*	B	--	--
	SB Right		11.7	B	3	59	11.4	B	1	31
	SB Approach		*11.7*	B	--	--	*11.4*	B	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.

Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
5. Route 54 (E-W) at	EB Thru		†	†	--	--	†	†	--	15
I-95 SB Ramps	EB Right		†	†	--	8	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left	435	9.0	A	20	86	9.8	A	21	98
	WB Thru		†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	SB Left - Thru	150	86.0	F	9	38	220.7	F	62	79
	SB Right		21.7	C	80	0	20.4	C	73	0
	SB Approach		*23.2*	C	--	--	*39.5*	E	--	--
6. Route 54 (E-W) at	EB Left	435	9.6	A	16	124	9.9	A	25	119
I-95 NB Ramps	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	10	†	†	--	7
	WB Right	380	†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		9.9	A	16	0	11.1	B	29	0
	NB Approach		*9.9*	A	--	--	*11.1*	B	--	--
	SB Right		68.1	F	472	0	67.4	F	458	0
	SB Approach		*68.1*	F	--	--	*67.4*	F	--	--
7. Route 54 (E-W) at	EB Left		9.0	A	3	64	8.9	A	3	52
Telcourt Rd (N-S)	EB Thru		†	†	--	--	†	†	--	0
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	--	†	†	--	--
	WB Right	50	†	†	--	25	†	†	--	27
	WB Approach		†	†	--	--	†	†	--	--
	SB Left - Right		12.8	B	2	35	10.7	B	4	40
	SB Approach		*12.8*	B	--	--	*10.7*	*B*	--	--
8. Route 54 (E-W) at	EB Left		8.4	A	4	41	8.3	A	2	31
Mt. Hermon Rd/Frances Rd (N-S)	EB Thru - Right		†	†	--	0	†	†	--	4
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left - Thru		0.4	A	1	61	0.3	A	1	56
	WB Right	110	†	†	--	2	†	†	--	0
	WB Approach		0.4	A	--	--	†	†	--	--
	NB Left-Thru-Right		24.6	C	17	59	28.8	D	33	63
	NB Approach		*24.6*	C	--	--	*28.8*	D	--	--
	SB Left-Thru-Right		12.9	B	9	44	12.8	B	6	50
	SB Approach		*12.9*	B	--	--	*12.8*	*B*	--	--
9. Route 54 (E-W) at	EB Left	300	8.1	A	5	48	8.4	A	13	72
Woodside Ln (N-S)	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru - Right		†	†	--	4	†	†	--	6
	WB Approach		†	†	--	--	†	†	--	--
	SB Left		12.8	B	20	72	14.0	B	19	63
	SB Right	290	12.8	B	20	103	14.0	B	19	78
	SB Approach		*12.8*	B	--	--	*14.0*	*B*	--	--
10. Route 54 (E-W) at	EB Thru		†	†	--	2	†	†	--	--
Goddins Hill Rd (N-S)	EB Right	200	†	†	--	4	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left - Thru		2.9	A	7	69	1.3	A	3	45
	WB Approach		*2.9*	A	--	--	*1.3*	*A*	--	--
	NB Left - Right		13.2	B	11	55	12.5	B	17	56
	NB Approach		*13.2*	B	--	--	*12.5*	*B*	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

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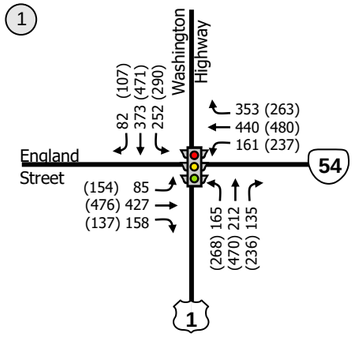
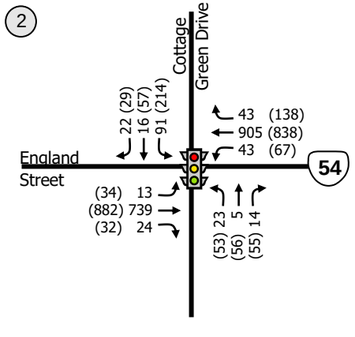
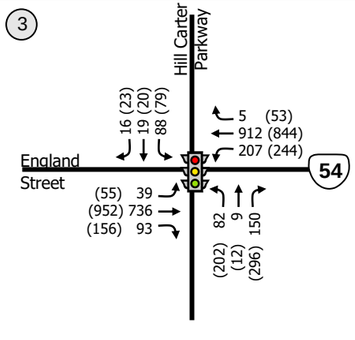
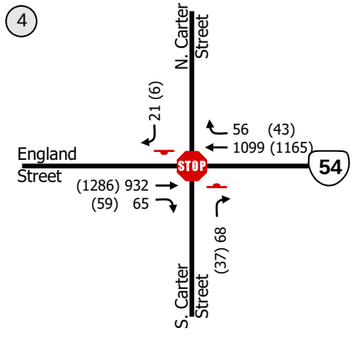
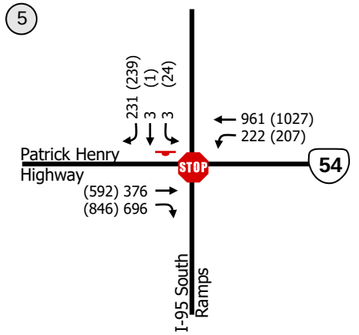
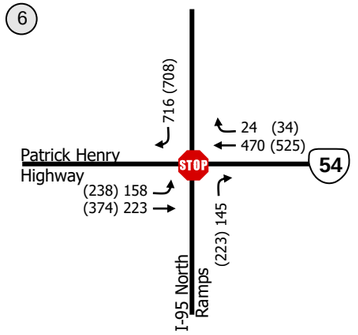


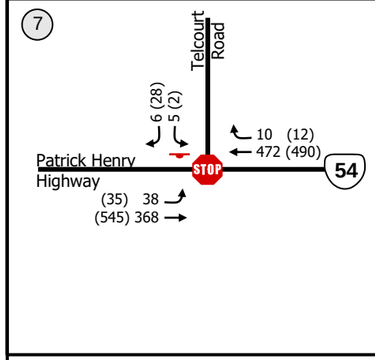


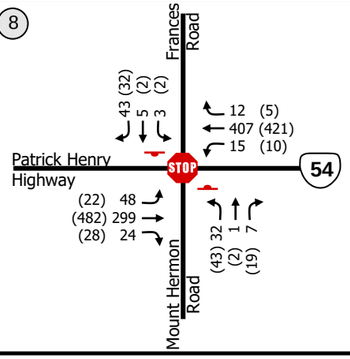


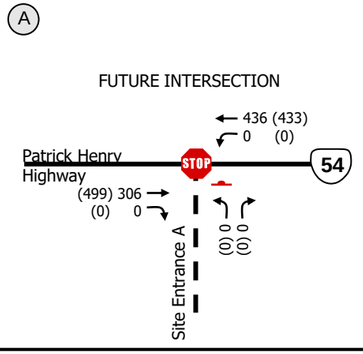


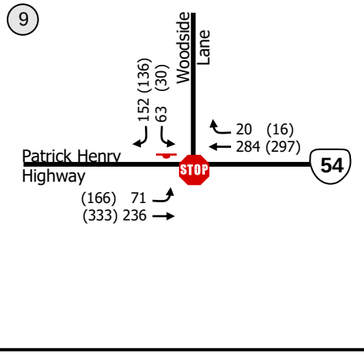


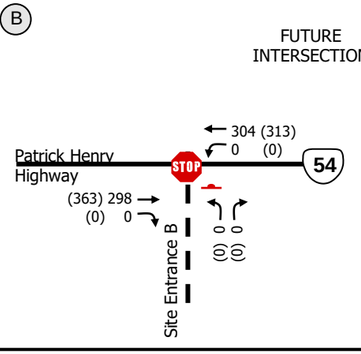


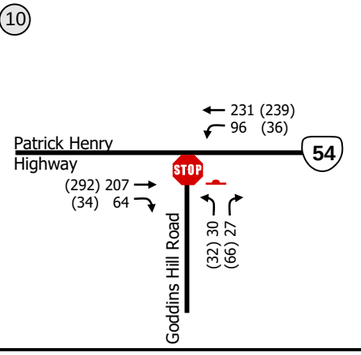






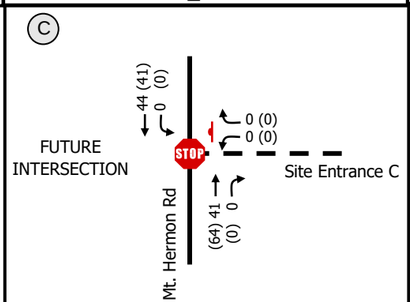






LEGEND:

- Existing Road
- Proposed Road
- XX AM Traffic Volume
- (XX) PM Traffic Volume
- Signalized Intersection
- STOP Stop Controlled Intersection



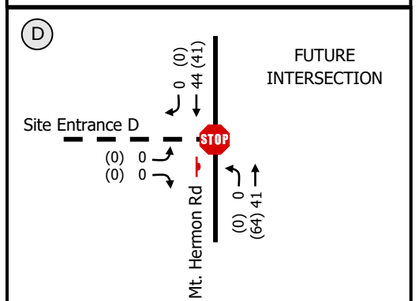


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Figure
6-1

7 2038 BACKGROUND CONDITIONS

The background 2038 volumes were analyzed assuming future intersection geometry in conjunction with projected background traffic volumes. The background traffic volumes were developed based on a 1.5% annual growth rate and the completion of one (1) other development in the study area.

7.1 BACKGROUND FORECASTING METHODOLOGY

The 1.5% annual growth rate discussed above was compounded annually for the 15-year period from 2022 to 2038 and applied to the existing traffic volumes. The resulting 2038 Background Traffic Volumes are shown on Figure 7-1.

7.2 BACKGROUND 2038 CAPACITY ANALYSES

Table 7-1 summarizes the 2038 background intersection LOS, delay, 95th percentile (Synchro and SIDRA), and maximum (SimTraffic) queue lengths based on the 2038 background peak hour traffic volumes shown on Figure 7-1, the existing conditions lane geometry (Figure 2-1), and the existing timings at the traffic signals. Note that intersections A-D are shown as numbers 11-14 in the following analysis. The corresponding SYNCHRO and SIDRA worksheets are included in Appendix H.

Note at Intersection #3 that the eastbound right movement is reporting excessive delay. This is an error with how Synchro is reporting delay for the intersection and may be caused by the pedestrian phase associated with the eastbound approach being turned on all the time. However, the 95th Percentile queue length is low which shows that vehicles are not waiting for the amount of time suggested by the control delay.

Note at Intersection #6 the I-95 off-ramps (SB right and NB right) are coded in Synchro as yield controlled approaches due to the existing signs at the intersection. However, the existing lane geometry for those movements includes a receiving lane for merging traffic. As shown by the SimTraffic queue lengths (0 ft), these movements operate as free-flowing despite the HCM reports showing delay.

As shown in Table 6-1 under 2038 background conditions:

- At the signalized intersection of Route 54 and Washington Highway, the overall intersection will operate at a LOS C/D during the AM/PM peaks, respectively.
    - The eastbound approach will operate at a LOS C/D during the AM/PM peaks, respectively. The westbound approach will operate at a LOS C/D during the AM/PM peaks, respectively. The WB through will operate at a LOS D/E during the AM/PM peaks, respectively.
    - The northbound left will operate at a LOS C/E during the AM/PM peaks, respectively. The NB through will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach and through movement will both operate at a LOS D/E during the AM/PM peaks, respectively.

    - During the PM peak, the NB left maximum queue fills the available storage. During the PM peak, the SB left maximum queue exceeds the available storage, spilling into the through lanes and backing up through the intersection of College Ave. All other movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Cottage Green Drive, the overall intersection will operate at a LOS B/C during the AM/PM peaks, respectively.
    - The mainline through movements will operate at a LOS C or better during both peak hours. The EB left will operate at a LOS D during both peak hours. The WB left will operate at a LOS E during both peak hours.
    - The northbound approach will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach will operate at a LOS D during both peak hours.
    - During the PM peak, the SB left maximum queue exceeds the available storage, spiling back into the through lane. All other movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Hill Carter Parkway, the overall intersection will operate at a LOS C/D during the AM/PM peaks, respectively.
    - The mainline through movements will operate at a LOS C during both peak hours. The EB and WB lefts will operate at a LOS D during both peak hours. As previously mentioned, the delay for the EB right is not reported correctly at this intersection.
    - The northbound approach will operate at a LOS D during both peak hours. The NB left will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach and left movement will operate at a LOS E during both peak hours.
    - All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the unsignalized intersection of Route 54 and I-95 SB ramp, the mainline east- and westbound approaches operate at a LOS B or better during both peak hours. The southbound left/through movement operates at a LOS F during both peak hours.
    - All other movements have adequate storage to accommodate 95th percentile and maximum queue lengths.

- At the unsignalized intersection of Route 54 and I-95 NB ramp, the mainline east- and westbound approaches operate at a LOS B during both peak hours. As previously mentioned, the north- and southbound movements report delay due to the yield-control, however the movements behave more like free-flow right turns. The NB right operates at a LOS B during both peak hours. The SB right operates at a LOS F during both peak hours. All 95th percentile and maximum queue lengths are contained within the available storage.

- At the unsignalized intersection of Route 54 and Mt. Hermon Road/Frances Road, the mainline east- and westbound movements will operate at a LOS A during both peak hours. The northbound approach will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach will operate at a LOS B during both peak hours. All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At all other unsignalized intersections (numbers 4, 7, 9-10), the mainline east- and westbound movements all operate at a LOS A during both peak hours. All side street movements operate at acceptable levels (LOS B or better) during both peak hours. All 95th percentile and maximum queue lengths are contained within the available storage.

Table 7-1: Intersection Level of Service and Delay Summary
2038 Background Peak Hour Traffic

Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
1. Route 54 (E-W) at	EB Left	290	25.4	C	68	160	37.9	D	159	228
Washington Hwy (N-S)	EB Thru		34.0	C	202	257	39.4	D	251	304
Signalized	EB Right	300	28.5	C	19	108	32.7	C	20	114
	EB Approach		*31.6*	*C*	--	--	*37.9*	*D*	--	--
	WB Left		20.3	C	89	252	47.0	D	241	761
	WB Thru		48.6	D	#545	560	71.9	E	#665	881
	WB Right		0.4	A	49	0	0.3	A	0	576
	WB Approach		26.0	C	--	--	46.6	D	--	--
	NB Left	350	33.7	C	145	168	68.3	E	#358	335
	NB Thru		38.6	D	117	153	72.2	E	#328	454
	NB Right	400	0.2	A	0	0	0.2	A	0	0
	NB Approach		*26.9*	*C*	--	--	*53.7*	*D*	--	--
	SB Left	320	47.5	D	#280	311	95.4	F	#413	320
	SB Thru		46.3	D	#214	392	74.7	E	#331	557
	SB Right	140	35.0	C	0	140	42.7	D	0	140
	SB Approach		*45.4*	*D*	--	--	*77.7*	*E*	--	--
	Overall		**32.3**	**C**	--	--	**54.2**	**D**	--	--
2. Route 54 (E-W) at	EB Left	235	49.5	D	m12	62	49.9	D	m50	98
Cottage Green Dr (N-S)	EB Thru - Right		17.7	B	123	256	21.5	C	m228	260
Signalized	*EB Approach*		*18.2*	*B*	--	--	*22.5*	*C*	--	--
	WB Dual Left	260	74.9	E	34	97	*66.9*	E	m40	124
	WB Thru - Right		4.5	A	30	245	*13.6*	B	200	347
	WB Approach		*7.5*	*A*	--	--	*17.7*	*B*	--	--
	NB Left		48.5	D	43	87	*56.9*	E	88	114
	NB Thru		45.8	D	14	52	56.9	E	92	108
	NB Right	170	45.3	D	0	34	52.4	D	0	76
	NB Approach		*47.1*	*D*	--	--	*55.4*	*E*	--	--
	SB Left	155	44.2	D	113	147	47.1	D	262	154
	SB Thru - Right		40.0	D	42	130	39.5	D	102	344
	SB Approach		*42.9*	*D*	--	--	*44.9*	*D*	--	--
	Overall		**15.0**	**B**	--	--	**25.1**	**C**	--	--
3. Route 54 (E-W) at	EB Left	325	35.7	D	m47	124	42.3	D	m98	140
Hill Carter Pkwy (N-S)	EB Thru		31.7	C	256	466	32.6	C	360	563
Signalized	EB Right	190	23.2	C	21	190	122.9	F	129	190
	EB Approach		*30.9*	*C*	--	--	*45.2*	*D*	--	--
	WB Dual Left	550	39.2	D	113	146	*51.8*	D	155	176
	WB Thru - Right		21.3	C	252	241	*24.3*	C	270	259
	WB Approach		*24.6*	*C*	--	--	*30.2*	*C*	--	--
	NB Left	220	44.5	D	72	60	*60.1*	E	#225	169
	NB Left - Thru		42.9	D	40	120	50.0	D	90	197
	NB Right	325	42.7	D	0	162	49.2	D	#117	268
	NB Approach		*43.0*	*D*	--	--	*51.5*	*D*	--	--
	SB Left	290	64.2	E	115	242	*59.9*	*E*	122	195
	SB Thru - Right		40.0	D	21	63	48.1	D	27	68
	SB Approach		*57.2*	*E*	--	--	*55.7*	*E*	--	--
	Overall		**30.5**	**C**	--	--	**40.9**	**D**	--	--
4. Route 54 (E-W) at	EB Thru - Right		†	†	--	180	†	†	--	204
Carter Rd (N-S)	*EB Approach*		†	†	--	--	†	†	--	--
Unsignalized	WB Thru - Right		†	†	--	8	†	†	--	24
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		11.9	B	11	85	13.6	B	8	78
	NB Approach		*11.9*	B	--	--	*13.6*	B	--	--
	SB Right		12.2	B	4	72	11.9	B	1	29
	SB Approach		*12.2*	B	--	--	*11.9*	B	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.

Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
5. Route 54 (E-W) at	EB Thru		†	†	--	5	†	†	--	9
I-95 SB Ramps	EB Right		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left	435	9.2	A	23	91	10.2	B	25	110
	WB Thru		†	†	--	0	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	SB Left - Thru	150	125.9	F	17	34	417.4	F	86	103
	SB Right		27.3	D	110	0	25.1	D	99	28
	SB Approach		*30.1*	*D*	--	--	*63.3*	*F*	--	--
6. Route 54 (E-W) at	EB Left	435	10.0	B	19	131	10.4	B	30	139
I-95 NB Ramps	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	12	†	†	--	17
	WB Right	380	†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		10.1	B	18	0	11.6	B	34	0
	NB Approach		*10.1*	*B*	--	--	*11.6*	*B*	--	--
	SB Right		116.3	F	682	0	115.8	F	662	0
	SB Approach		*116.3*	*F*	--	--	*115.8*	*F*	--	--
7. Route 54 (E-W) at	EB Left		9.3	A	4	72	9.1	A	3	57
Telcourt Rd (N-S)	EB Thru		†	†	--	--	†	†	--	0
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	5	†	†	--	2
	WB Right	50	†	†	--	27	†	†	--	28
	WB Approach		†	†	--	--	†	†	--	--
	SB Left - Right		13.5	B	2	31	11.3	B	5	46
	SB Approach		*13.5*	*B*	--	--	*11.3*	*B*	--	--
8. Route 54 (E-W) at	EB Left		8.5	A	4	39	8.5	A	2	28
Mt. Hermon Rd/Frances Rd (N-S)	EB Thru - Right		†	†	--	0	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left - Thru		0.4	A	1	60	0.4	A	1	77
	WB Right	110	†	†	--	0	†	†	--	0
	WB Approach		†	†	--	--	†	†	--	--
	NB Left-Thru-Right		29.6	D	24	73	37.5	E	46	74
	NB Approach		*29.6*	*D*	--	--	*37.5*	*E*	--	--
	SB Left-Thru-Right		13.8	B	11	51	14.2	B	9	54
	SB Approach		*13.8*	*B*	--	--	*14.2*	*B*	--	--
9. Route 54 (E-W) at	EB Left	300	8.2	A	5	56	8.6	A	15	73
Woodside Ln (N-S)	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru - Right		†	†	--	--	†	†	--	2
	WB Approach		†	†	--	--	†	†	--	--
	SB Left		13.7	B	24	96	15.3	C	23	63
	SB Right	290	13.7	B	24	90	15.3	C	23	81
	SB Approach		*13.7*	B	--	--	*15.3*	*C*	--	--
10. Route 54 (E-W) at	EB Thru		†	†	--	--	†	†	--	--
Goddins Hill Rd (N-S)	EB Right	200	†	†	--	7	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left - Thru		3.0	A	8	60	1.4	A	3	52
	WB Approach		*3.0*	A	--	--	*1.4*	*A*	--	--
	NB Left - Right		14.1	B	13	66	13.3	B	20	73
	NB Approach		*14.1*	B	--	--	*13.3*	*B*	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.

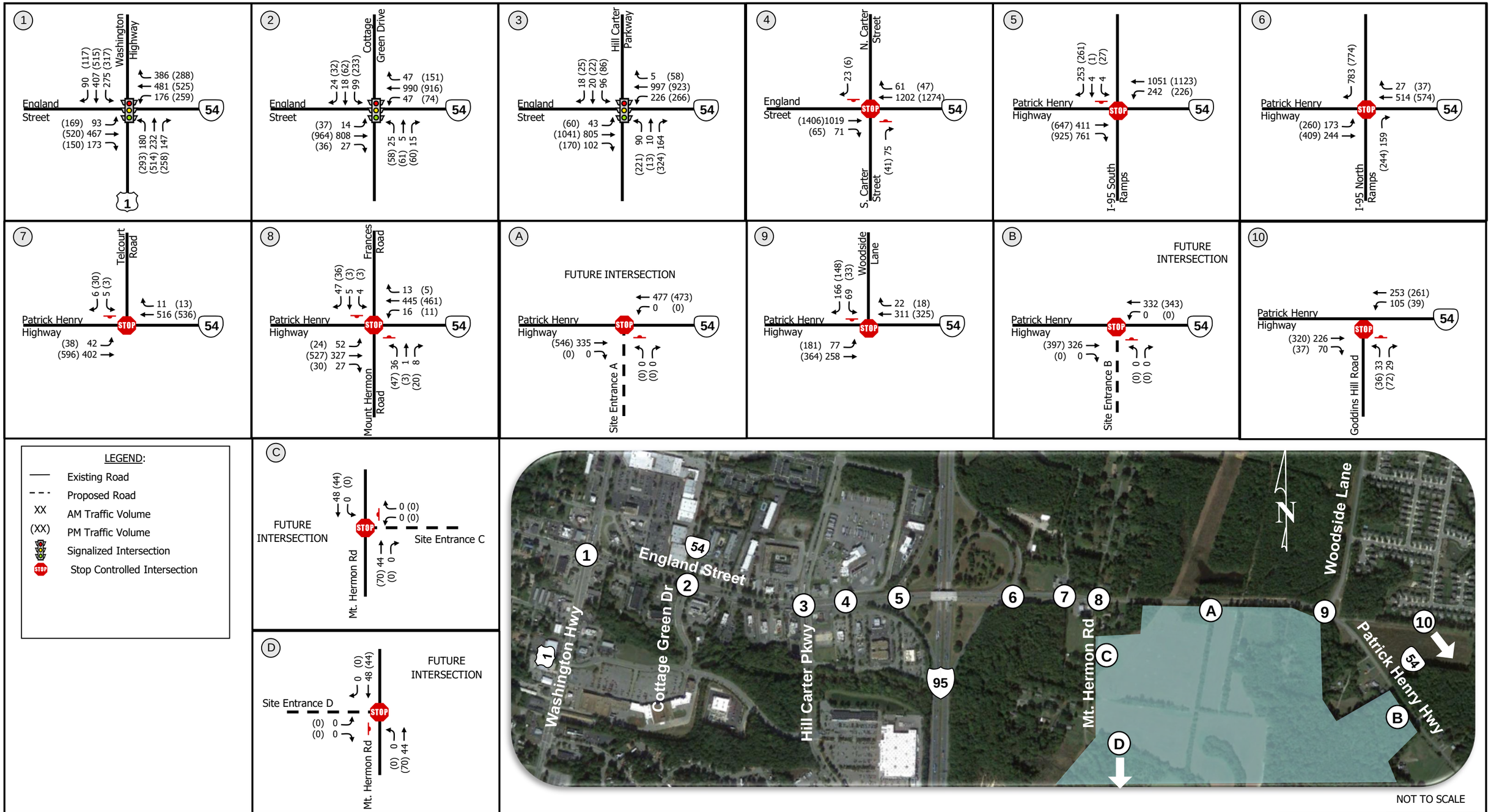

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Figure
7-1

8 TRIP GENERATION AND DISTRIBUTION

8.1 SITE TRIP GENERATION

The site-generated traffic volumes shown in Table 8-1 were estimated using the 11th Edition of the Institute of Transportation Engineers' (ITE) *Trip Generation Manual* and were calculated using the number of dwelling units or the size of the building (S.F.) as the independent variable for the land uses associated with the existing zoning and proposed rezoning portions of the site.

The buildout of the development is anticipated to occur between 2027 and 2032. For the purposes of this analysis, Phase 1 will be completed by 2027 and will include 100% of the residential townhomes. Phase 2 will be completed by 2027 and includes 40% of the overall retail, office, and industrial land uses. Phase 3 will be completed by 2032 and includes the remaining 60% of the overall retail, office, and industrial land uses. A conceptual site plan is shown on Figure 1-2.
As shown in Table 8-1, when complete, the total proposed development will generate 1,251 net external trips (869 in and 382 out) during the AM peak, 1,322 net external trips (458 in and 864 out) during the PM peak, and 11,812 net external weekday daily trips. The total proposed development will generate 342 total pass-by trips (176 in and 166 out) during the AM peak, 269 total pass-by trips (145 in and 124 out) during the PM peak, and 4,047 total pass-by weekday daily trips.

Phase 1 (residential townhomes only) of the proposed development will generate 70 external trips (22 in and 48 out) during the AM peak, 84 external trips (48 in and 36 out) during the PM peak, and 1,062 external weekday daily trips.

Phase 2 (40% of the retail, office, and industrial land uses) of the proposed development will generate 472 net external trips (339 in and 134 out) during the AM peak, 495 net external trips (164 in and 331 out) during the PM peak, and 4,300 net external weekday daily trips.

Phase 3 (60% of the retail, office, and industrial land uses) of the proposed development will generate 709 net external trips (508 in and 200 out) during the AM peak, 743 net external trips (246 in and 497 out) during the PM peak, and 6,450 net external weekday daily trips.

Table 8-1: Trip Generation Summary

Buildout - Iron Horse Business Center				Weekday						
			Land Use	AM Peak Hour			PM Peak Hour			Average
Land Use	Size	Units	Code	In	Out	Total	In	Out	Total	Daily Trips
1. ITE Trip Generation[1]										
Residential										
Townhomes	146	Units	215	22	48	70	48	36	84	1,062
Retail										
Sit-Down Restaurant (High Turnover)	21,000	S.F.	932	111	90	201	115	75	190	2,251
Fast-Food Restaurant with Drive-Thru	8,000	S.F.	934	182	175	357	137	127	264	3,740
Gas Station	12	Fueling Positions	944	61	62	123	83	84	167	2,064
Industrial										
Industrial Park Total Vehicles				535	125	660	145	515	660	4,388
Industrial Park Trucks (4% of total)	1,940,000	S.F.	130	35	43	78	30	48	78	1,055
Industrial Park Passenger Cars				500	82	582	115	467	582	3,333
Office & Lodging										
General Office Building	26,000	S.F.	710	46	7	53	9	45	54	359
Medical Office Building	26,000	S.F.	720	56	16	72	31	72	103	1,009
Hotel	130	Rooms	310	32	26	58	35	33	68	986
Total ITE Generated Trips				***1,045***	***548***	***1,593***	***603***	***988***	***1,591***	***15,859***
2. Pass-By/Diverted Link Trip Reduction[2]										
External Retail Trips				354	327	681	335	286	621	8,055
Gas Station Pass-By Trips	63% AM 57% PM			(38)	(39)	(77)	(47)	(48)	(95)	(1,238)
Fast-Food Restaurant Pass-By Trips	50% AM 55% PM			(91)	(88)	(179)	(48)	(44)	(92)	(1,964)
Sit-Down Restaurant Pass-By Trips	43% AM 43% PM[3]			(47)	(39)	(86)	(50)	(32)	(82)	(845)
Subtotal: Total Pass-By Trips				(176)	(166)	(342)	(145)	(124)	(269)	(4,047)
Total Primary External Retail Trips				***178***	***161***	***339***	***190***	***162***	***352***	***4,008***
Total ITE Site Trips Generated				**1,045**	**548**	**1,593**	**603**	**988**	**1,591**	**15,859**
Total Pass-By Trips				**(176)**	**(166)**	**(342)**	**(145)**	**(124)**	**(269)**	**(4,047)**
Total External Primary Trips				**869**	**382**	**1,251**	**458**	**864**	**1,322**	**11,812**
Total External Primary Trips, Phase 1[4]				**22**	**48**	**70**	**48**	**36**	**84**	**1,062**
Total External Primary Trips, Phase 2 (40% of total)[4]				**339**	**134**	**472**	**164**	**331**	**495**	**4,300**
Total External Primary Trips, Phase 3 (60% of total)[5]				**508**	**200**	**709**	**246**	**497**	**743**	**6,450**

Notes:

(1) Calculated from the Institute of Transportation Engineers *Trip Generation Manual* , 11th Edition. Assumes General Urban/Suburban land use category.

(2) Calculated from the Institute of Transportation Engineers *Trip Generation Manual* , 11th Edition Pass-By Rates.

(3) ITE only has a Pass-By percentage for the PM peak hour. This percentage was assumed to be the same for AM peak hour and average daily trips.

(4) Phase 1 will consist of 100% of the residential units. Phase 2 will consist of 40% of the industrial, office, and retail land uses. Both Phases 1 & 2 will open by 2027.

(5) Phase 3 will consist of the remaining 60% of the industrial, office, and retail land uses and willopen by 2032.

8.2 Pass-By Trip Reductions

Reductions were taken for the pass-by trips associated with the retail land uses (gas station, high-turnover sit-down restaurant, and fast-food restaurant). 10% of the trips were projected to come to/from I-95 northbound and were treated as a diverted link. Due to difficult left turns at the intersection of Route 54/I-95 SB Ramp and the presence of competing land uses available via a right turn; it was assumed that no I-95 southbound traffic would access the proposed development as diverted link pass-by trips.

The following directional distributions were assumed for the total pass-by trips to/from the proposed development:

- To/from the west on Route 54 – 90%
- To/from I-95 northbound – 10%
- To/from Entrance C (utilizing Mt. Hermon Rd) – 40%
- To/from Entrance A – 60%

The pass-by trip distribution was applied to the study intersections as shown on Figure 8-1.

8.3 Primary Trip Distribution Methodology

The distribution of external trips generated by the proposed development was based on the existing travel patterns, the nature of the site, and local knowledge.

The following directional distributions were assumed for primary passenger vehicle trips to/from the proposed development:

- To/from the west on Route 54 – 5%
- To/from the north on US Route 1 – 10%
- To/from the south on US Route 1 – 10%
- To/from the north on I-95 –25%
- To/from the south on I-95 – 40%
- To/from the east on Route 54 – 10%

The following directional distributions were assumed for primary truck trips to/from the proposed development:

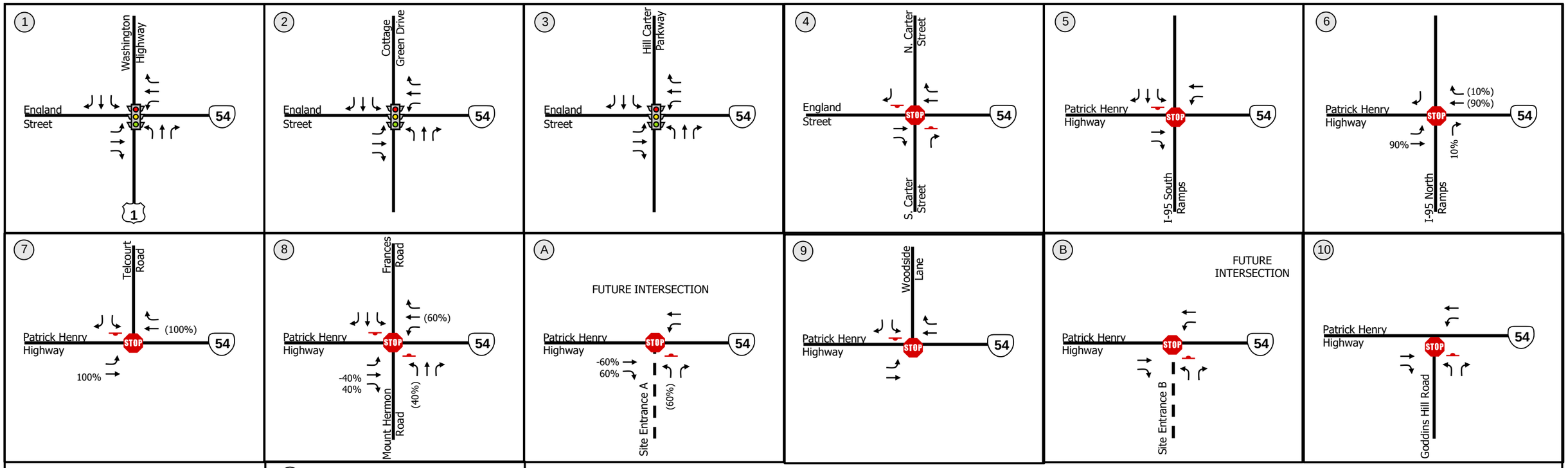
- To/from the north on US Route 1 – 10%
- To/from the south on US Route 1 – 10%
- To/from the north on I-95 –40%
- To/from the south on I-95 – 40%

Directional distributions were then applied to the study intersections as shown on Figure 8-2 (residential trips), Figure 8-3 (hotel trips), Figure 8-4 (retail, office, and industrial passenger car trips), and Figure 8-5 (industrial truck trips).

8.4 TRAFFIC ASSIGNMENT

The trip distribution percentages described above for the external and pass-by site trips were applied to the trip generation shown in Table 8-1 to distribute the external site trips for each phase to the surrounding roadway network according to the phased build out of the proposed development. The resulting site generated external trips for passenger cars in Phase 1, Phase 2, and Phase 3 are shown on Figures 8-6, 8-7, and 8-8 respectively.

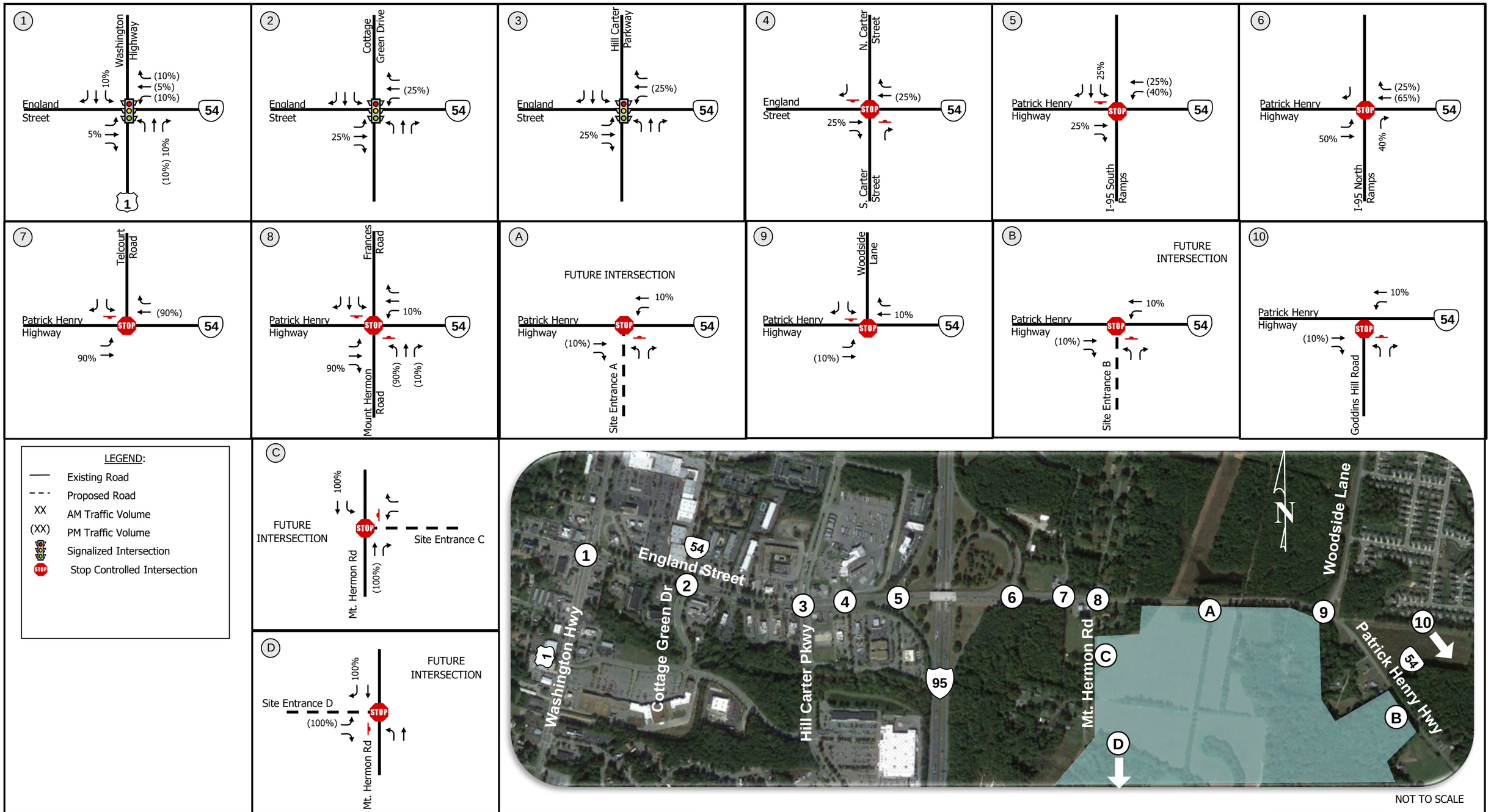
The resulting site generated external trips for trucks in Phase 2 and Phase 3 are shown on Figures 8-9 and 8-10, respectively. The resulting pass-by trips in Phase 2 and Phase 3 are shown on Figures 8-11 and 8-12, respectively.



TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
Retail Pass-By Trip Distribution

Figure
8-1



NOT TO SCALE

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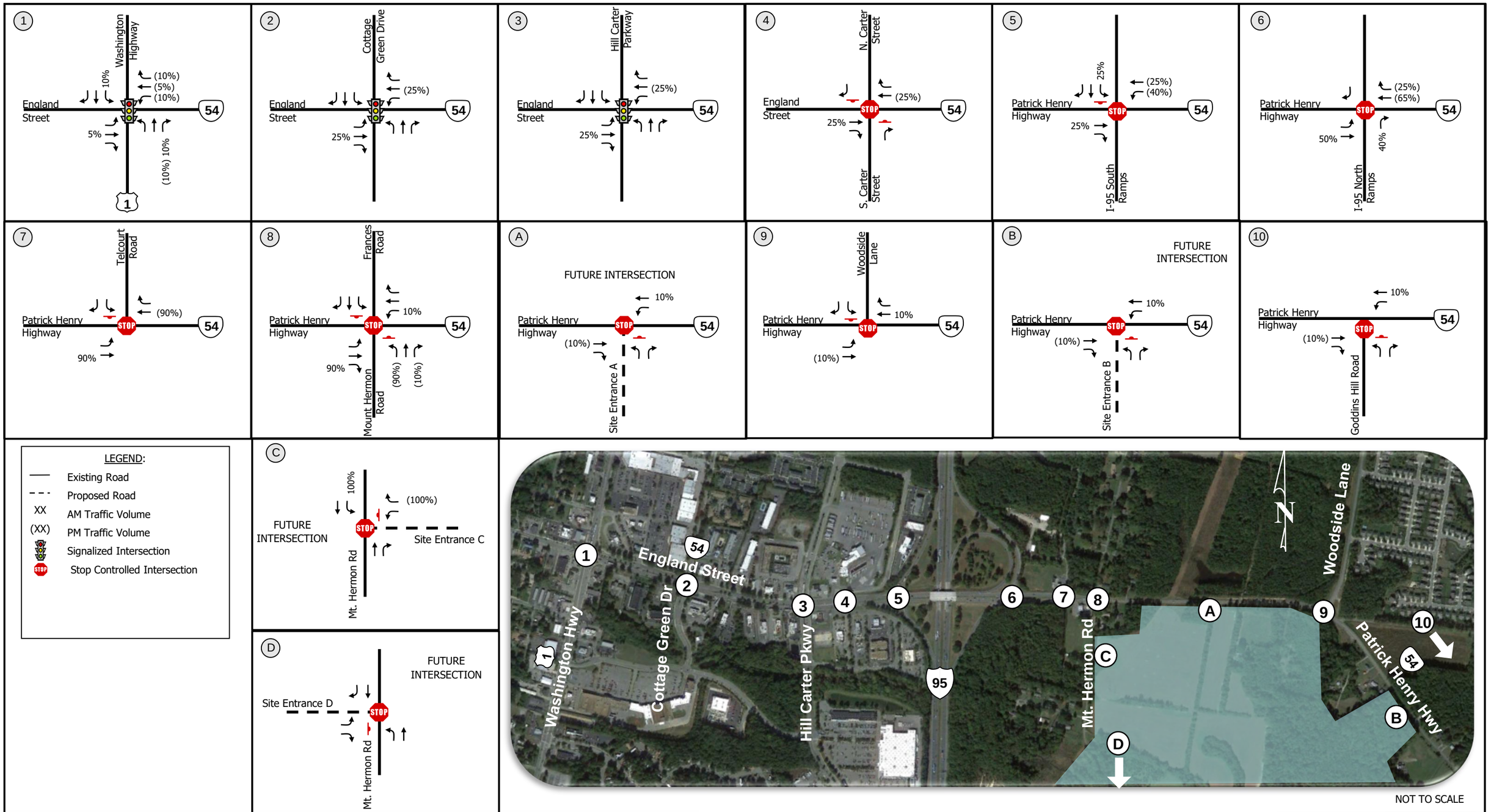
VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
Townhomes Trip Distribution

Figure
8-2



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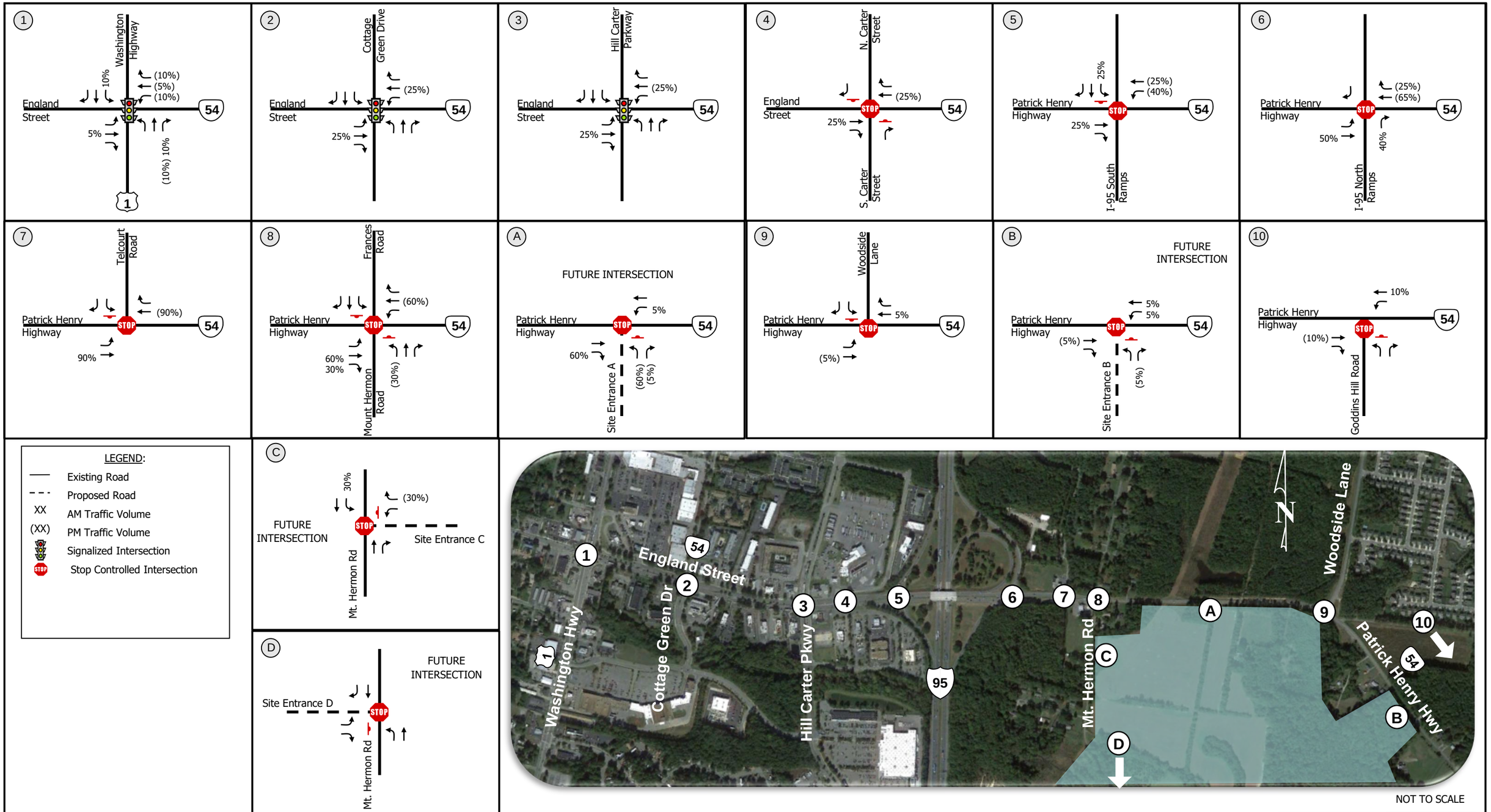
VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
Hotel Trip Distribution

Figure
8-3



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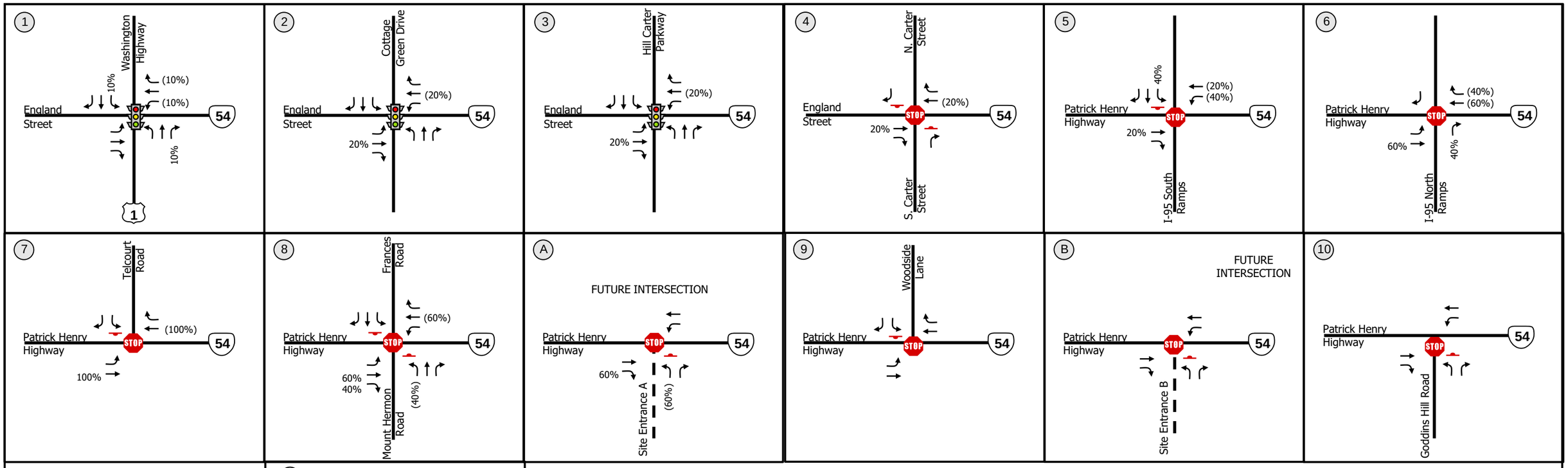
VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
Retail, Industrial, Office Trip Distribution (Passenger Cars)

Figure
8-4



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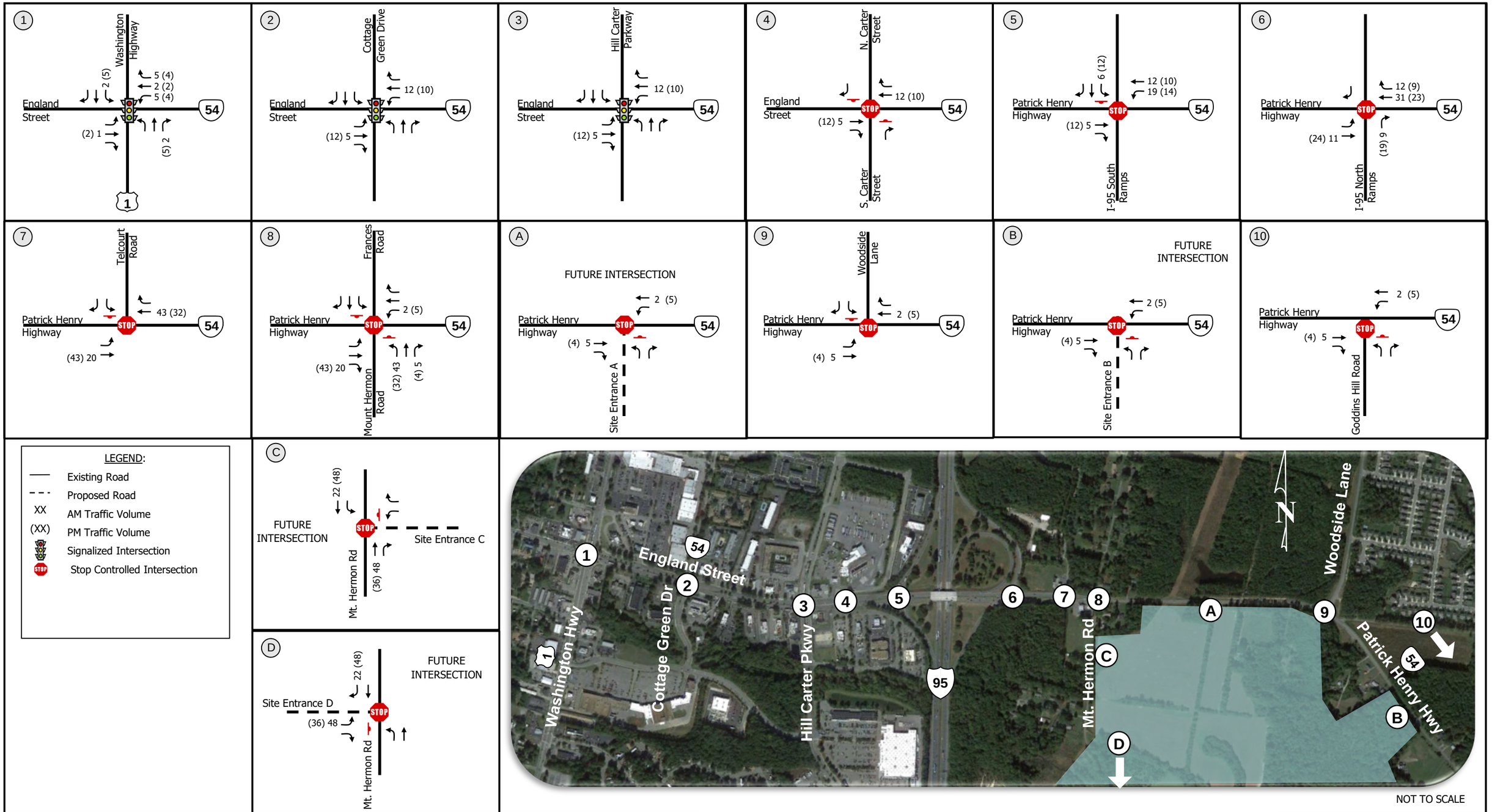
VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
Industrial Trip Distribution (Trucks)

Figure
8-5



NOT TO SCALE

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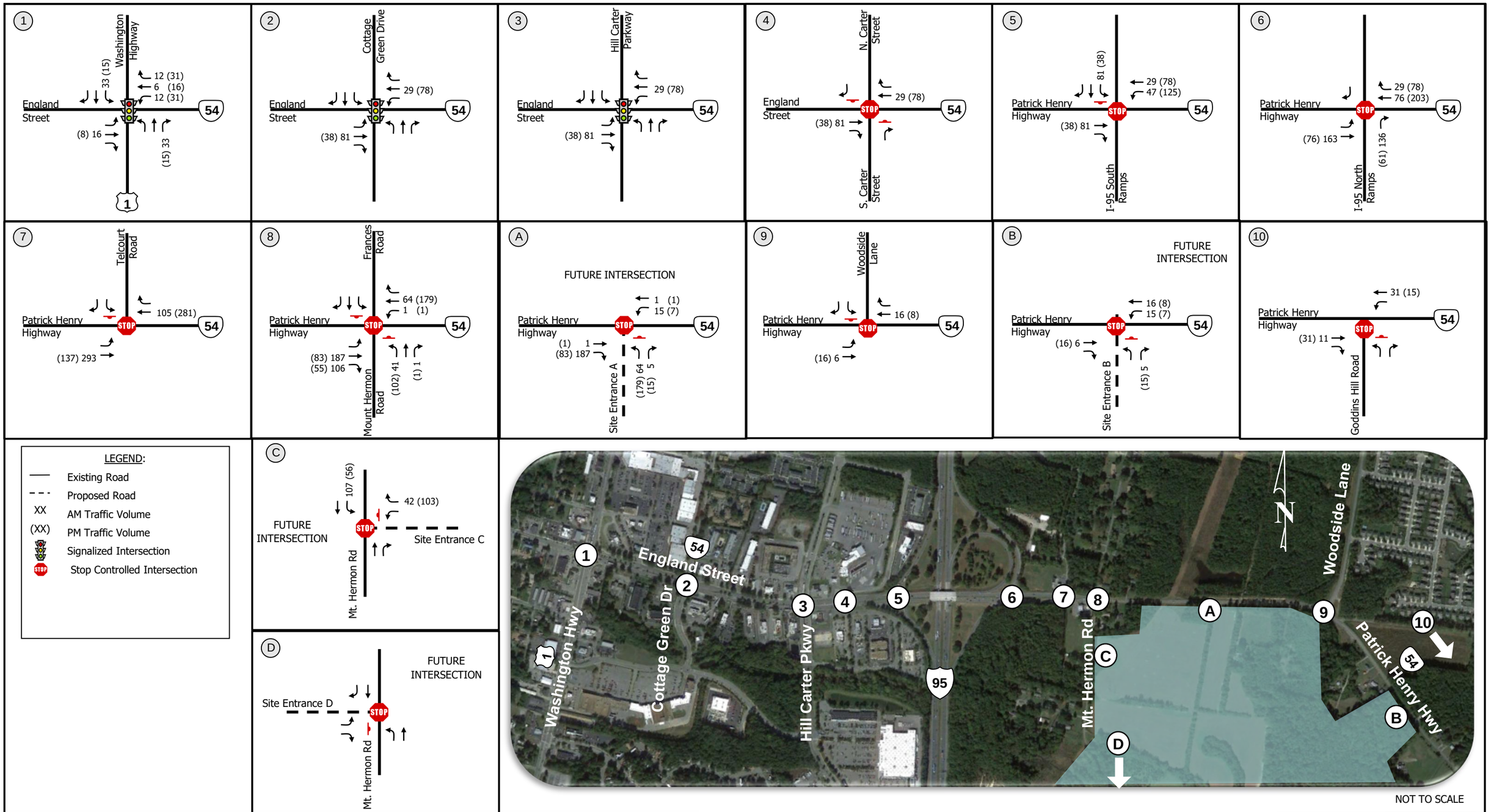
VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
Phase 1 Townhome Site Trips

Figure
8-6



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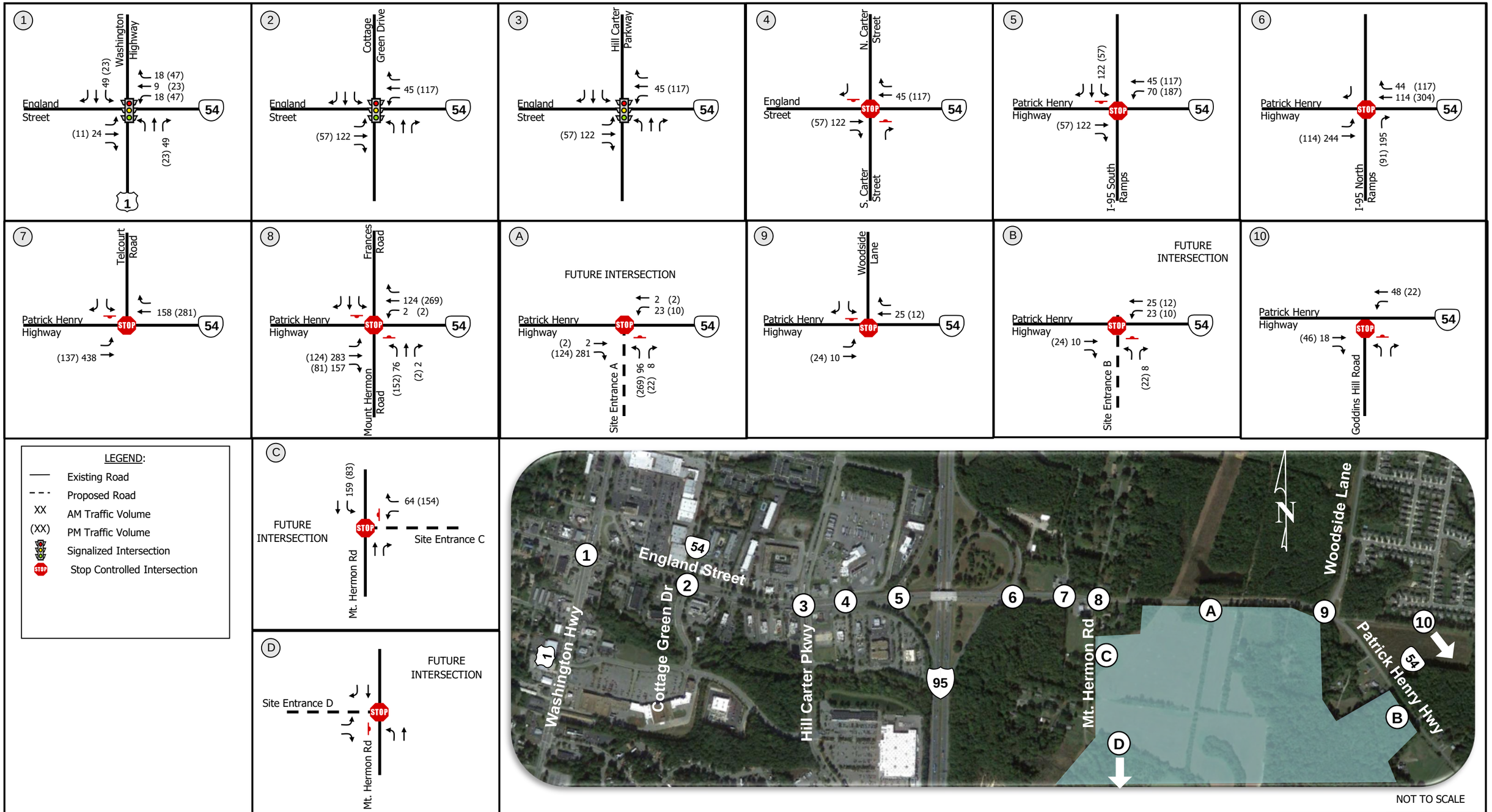
VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
Phase 2 Site Trips (Passenger Car)

Figure
8-7



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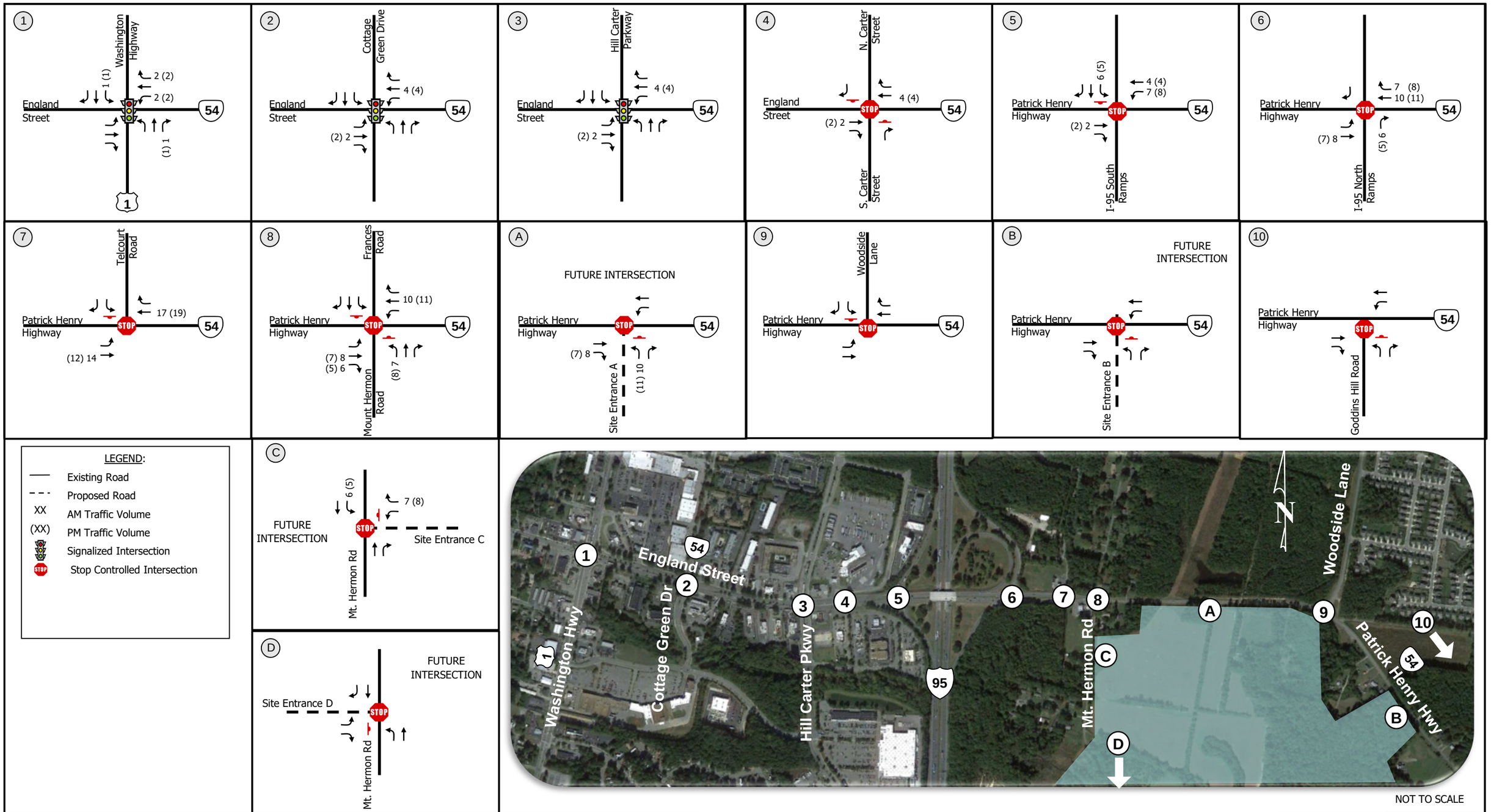
VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
Phase 3 Site Trips (Passenger Car)

Figure
8-8



TIMMONS GROUP
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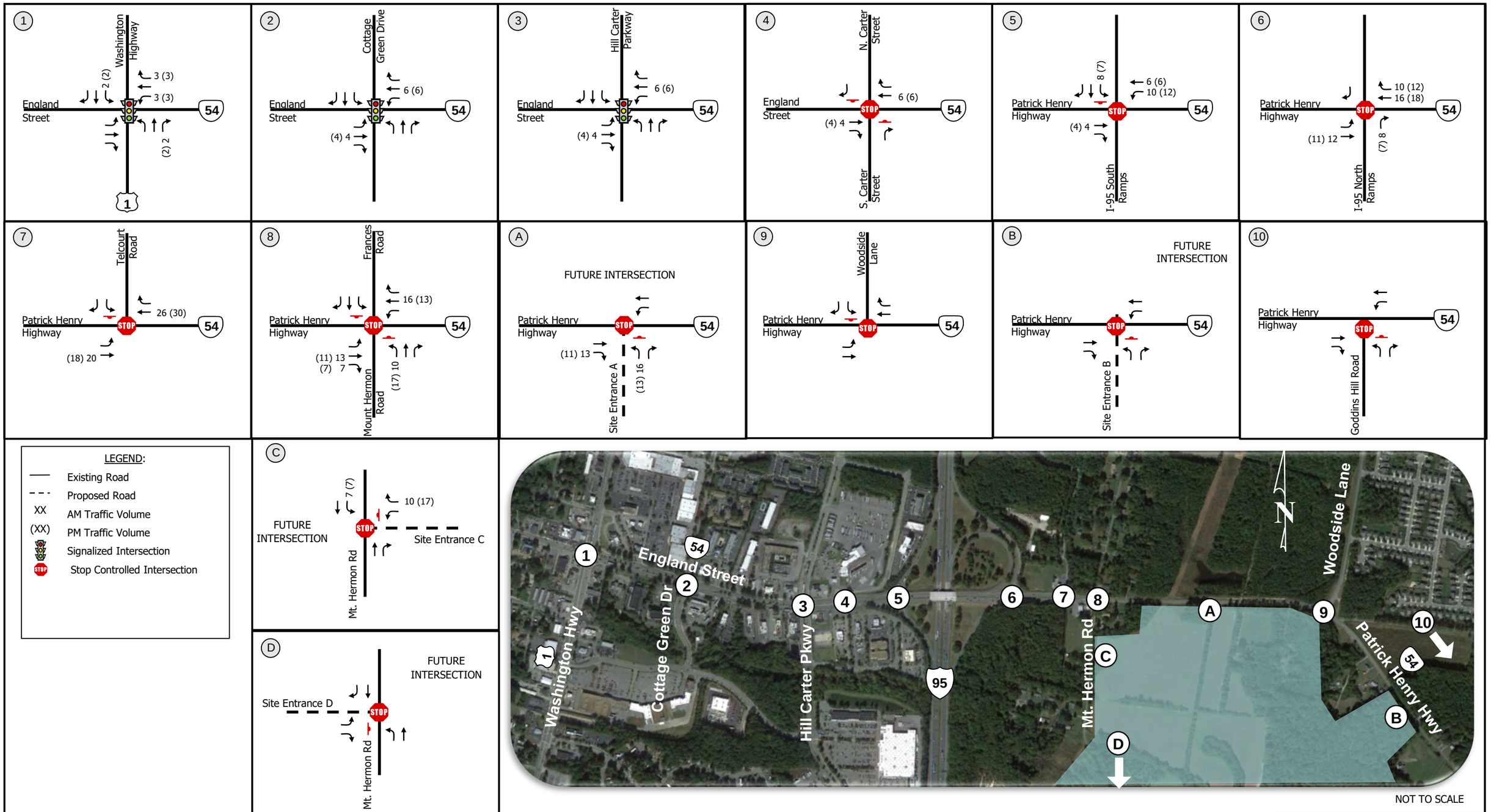
VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
Phase 2 Site Trips (Trucks)

Figure
8-9



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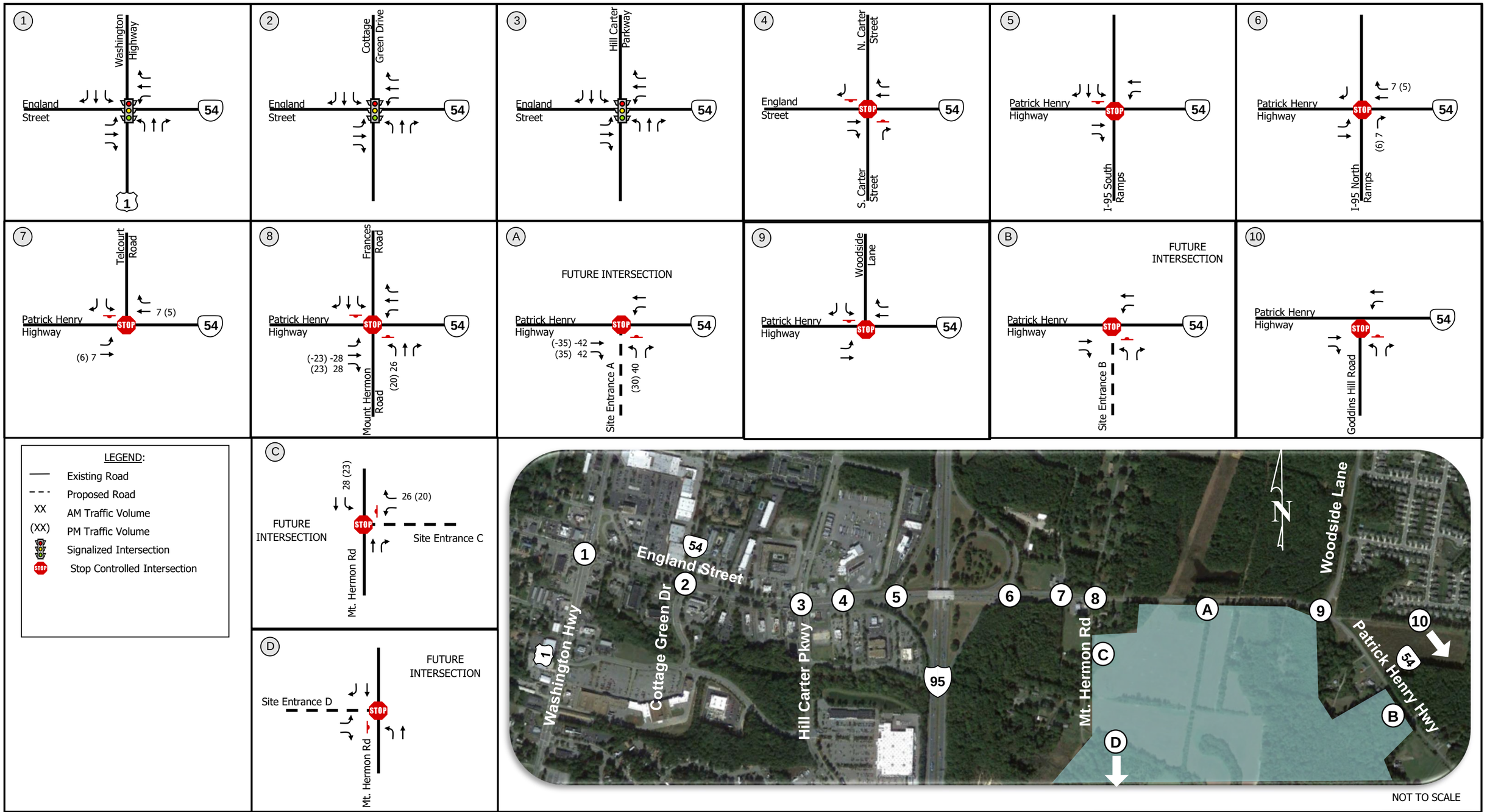
VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
Phase 3 Site Trips (Trucks)

Figure
8-10



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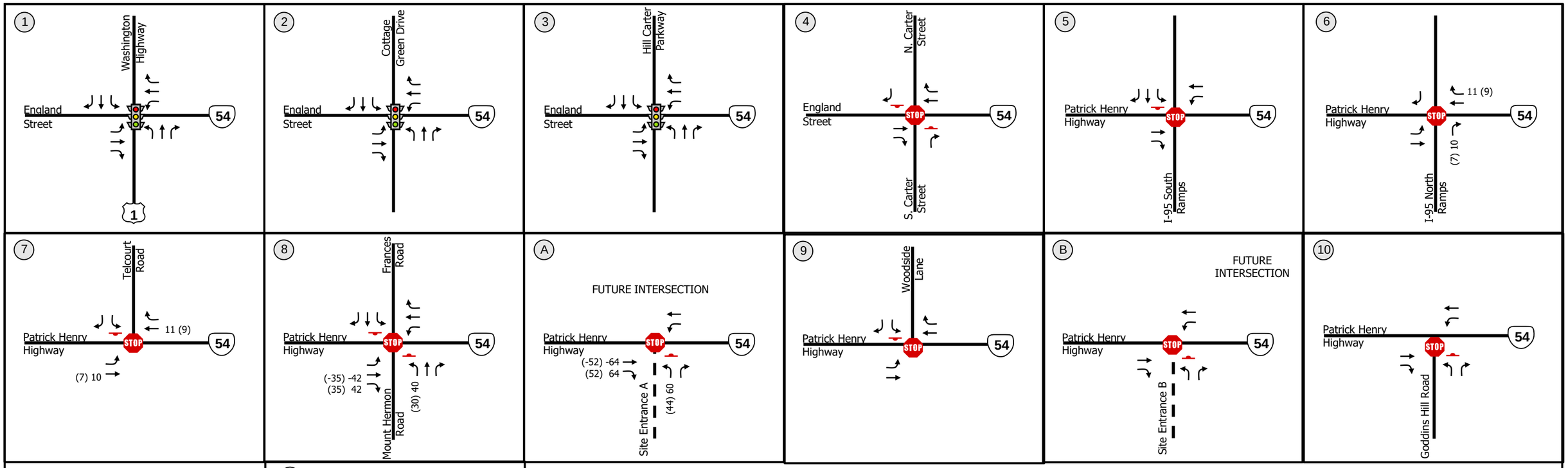
VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
Phase 2 Pass-By Site Trips

Figure
8-11



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VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
Phase 3 Pass-By Site Trips

Figure
8-12

9 2027 TOTAL FUTURE CONDITIONS (PHASE 1)

To complete the analysis of the 2027 total conditions (with Phase 1 of the proposed development), the estimated site trips were added to the background 2027 volumes. The projected volumes were then used to complete the capacity analysis.

9.1 TOTAL FUTURE TRAFFIC VOLUMES

To generate the 2027 total future traffic volumes, the Phase 1 external site trips shown on Figure 8-6 was added to the background 2027 traffic volumes shown on Figure 5-1. The resulting 2027 (Phase 1) total future traffic volumes are shown on Figure 9-1.

9.2 2027 TOTAL FUTURE CAPACITY ANALYSES

Table 9-1 summarizes the 2027 total future intersection LOS, delay, 95th percentile (Synchro and SIDRA), and maximum (SimTraffic) queue lengths based on the 2027 total future peak hour traffic volumes shown on Figure 9-1, the Phase 1 future lane geometry (Figure 2-2), and optimized timings at the traffic signals. Note that intersections A-D are shown as numbers 11-14 in the following analysis. The corresponding SYNCHRO and SIDRA worksheets for 2027 total future analyses are included in Appendix I.

Note at Intersection #3 that the eastbound right movement is reporting excessive delay. This is an error with how Synchro is reporting delay for the intersection and may be caused by the pedestrian phase associated with the eastbound approach being turned on all the time. However, the 95th Percentile queue length is low which shows that vehicles are not waiting for the amount of time suggested by the control delay.

Note at Intersection #6 the I-95 off-ramps (SB right and NB right) are coded in Synchro as yield controlled approaches due to the existing signs at the intersection. However, the existing lane geometry for those movements includes a receiving lane for merging traffic. As shown by the SimTraffic queue lengths (0 ft), these movements operate as free-flowing despite the HCM reports showing delay.

As shown in Table 9-1 under 2027 total future conditions (with Phase 1 of the proposed development):

- At the signalized intersection of Route 54 and Washington Highway, the overall intersection will operate at a LOS C/D during the AM/PM peaks, respectively.
    - The eastbound approach will operate at a LOS C/D during the AM/PM peaks, respectively. The westbound approach will operate at a LOS B/C during the AM/PM peaks, respectively.
    - The northbound left will operate at a LOS C/D during the AM/PM peaks, respectively. The NB through will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach and left movement will operate at a LOS D during both peak hours.
    - All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Cottage Green Drive, the overall intersection will operate at a LOS A/B during the AM/PM peaks, respectively.
    - The mainline through movements will operate at a LOS B or better during both peak hours. The EB left will operate at a LOS D during both peak hours. The WB left will operate at a LOS E/C during the AM/PM peaks, respectively.
    - The northbound approach will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach will operate at a LOS D during both peak hours. The SB left will operate at a LOS D/E during the AM/PM peaks, respectively.
    - During the PM peak, the SB left maximum queue exceeds the available storage, spiling back into the through lane. All other movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Hill Carter Parkway, the overall intersection will operate at a LOS C during both peak hours.
    - The mainline through movements will operate at a LOS C or better during both peak hours. The EB left will operate at a LOS D/C during the AM/PM peaks. The WB left will operate at a LOS D/E during the AM/PM peaks, respectively. As previously mentioned, the delay for the EB right is not reported correctly at this intersection.
    - The northbound approach and left movement will both operate at a LOS D during both peak hours. The southbound approach will operate at a LOS D/E during the AM/PM peaks, respectively. The SB left will operate at a LOS E during both peak hours.
    - All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the unsignalized intersection of Route 54 and I-95 SB ramp, mainline east- and westbound movements operate at a LOS A during both peak hours. The southbound left/through movement operates at a LOS F during both peak hours. All movements have adequate storage to accommodate 95th percentile and maximum queue lengths.

- At the unsignalized intersection of Route 54 and I-95 NB ramp, the mainline east- and westbound approaches operate at a LOS A during both peak hours. As previously mentioned, the north- and southbound movements report delay due to the yield-control, however the movements behave more like free-flow right turns. The NB right operates at a LOS B or better during both peak hours. The SB right operates at a LOS E during both peak hours. All maximum queue lengths are contained within the available storage.

- At the unsignalized intersection of Route 54 and Mt. Hermon Road/Frances Road, mainline movements will operate at a LOS A during both peak hours.
    - The northbound approach will operate at a LOS D during both peak hours. The southbound approach will operate at a LOS B during both peak hours.
    - All other movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At all other unsignalized intersections (numbers 4, 7, 9-10, 14), the mainline movements (free-flowing) all operate at a LOS A during both peak hours. All side street movements (stop-controlled) operate at acceptable levels (LOS B or better) during both peak hours. All 95th percentile and maximum queue lengths are contained within the available storage.

Table 9-1: Intersection Level of Service and Delay Summary
2027 Total Future Traffic (Phase 1)

Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
1. Route 54 (E-W) at	EB Left	290	31.1	C	59	133	43.9	D	110	218
Washington Hwy (N-S)	EB Thru		35.6	D	174	211	38.1	D	220	289
Signalized	EB Right	300	30.4	C	2	110	32.7	C	2	96
	EB Approach		*33.8*	*C*	--	--	*38.3*	*D*	--	--
	WB Left		11.4	B	35	186	24.0	C	168	291
	WB Thru		21.2	C	67	376	33.7	C	482	531
	WB Right		0.4	A	27	0	0.2	A	0	67
	WB Approach		11.8	B	--	--	22.3	C	--	--
	NB Left	350	32.0	C	126	189	42.8	D	#230	296
	NB Thru		39.2	D	103	162	58.0	E	#247	280
	NB Right	400	0.2	A	0	0	0.2	A	0	0
	NB Approach		*26.5*	*C*	--	--	*39.6*	*D*	--	--
	SB Left	320	41.9	D	#201	277	47.7	D	#268	277
	SB Thru		41.3	D	163	250	51.1	D	236	266
	SB Right	140	34.7	C	0	138	41.1	D	0	140
	SB Approach		*40.8*	*D*	--	--	*48.7*	*D*	--	--
	Overall		**26.8**	**C**	--	--	**36.8**	**D**	--	--
2. Route 54 (E-W) at	EB Left	235	43.6	D	m15	60	50.6	D	m49	85
Cottage Green Dr (N-S)	EB Thru - Right		4.5	A	66	154	14.3	B	226	310
Signalized	*EB Approach*		*5.2*	*A*	--	--	*15.6*	*B*	--	--
	WB Dual Left	260	60.0	E	23	72	*30.1*	C	46	88
	WB Thru - Right		1.2	A	8	197	*3.0*	A	67	263
	WB Approach		*3.8*	*A*	--	--	*4.7*	*A*	--	--
	NB Left		48.2	D	39	70	*56.9*	E	79	98
	NB Thru		45.9	D	13	68	56.7	E	81	106
	NB Right	170	45.5	D	0	35	52.8	D	0	74
	NB Approach		*47.1*	*D*	--	--	*55.5*	*E*	--	--
	SB Left	155	47.7	D	100	136	55.5	E	222	154
	SB Thru - Right		42.0	D	38	76	44.2	D	87	299
	SB Approach		*46.0*	*D*	--	--	*52.3*	*D*	--	--
	Overall		**8.0**	**A**	--	--	**18.1**	**B**	--	--
3. Route 54 (E-W) at	EB Left	325	47.6	D	44	108	28.5	C	m77	117
Hill Carter Pkwy (N-S)	EB Thru		13.0	B	190	374	9.2	A	85	285
Signalized	EB Right	190	22.1	C	12	190	7.3	A	m5	190
	EB Approach		*15.6*	*B*	--	--	*9.9*	*A*	--	--
	WB Dual Left	550	39.8	D	97	131	*56.4*	E	139	154
	WB Thru - Right		19.7	B	216	215	*24.2*	C	261	300
	WB Approach		*23.4*	*C*	--	--	*31.0*	*C*	--	--
	NB Left	220	43.8	D	61	73	*54.2*	D	139	150
	NB Left - Thru		42.7	D	34	110	49.6	D	73	176
	NB Right	325	42.4	D	0	126	48.9	D	82	241
	NB Approach		*42.7*	*D*	--	--	*50.1*	*D*	--	--
	SB Left	290	55.2	E	98	204	*63.9*	*E*	106	177
	SB Thru - Right		40.3	D	19	72	50.0	D	24	52
	SB Approach		*50.9*	*D*	--	--	*59.0*	*E*	--	--
	Overall		**23.9**	**C**	--	--	**27.1**	**C**	--	--
4. Route 54 (E-W) at	EB Thru - Right		†	†	--	58	†	†	--	58
Carter Rd (N-S)	*EB Approach*		†	†	--	--	†	†	--	--
Unsignalized	WB Thru - Right		†	†	--	5	†	†	--	14
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		11.1	B	9	74	12.4	B	6	64
	NB Approach		*11.1*	B	--	--	*12.4*	B	--	--
	SB Right		11.4	B	3	52	11.1	B	1	27
	SB Approach		*11.4*	B	--	--	*11.1*	B	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.

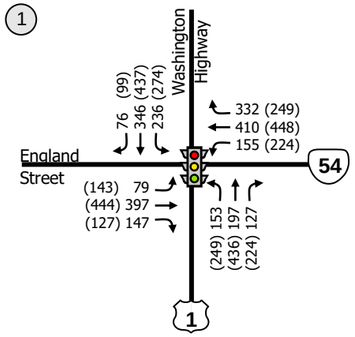
Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
5. Route 54 (E-W) at	EB Thru		†	†	--	--	†	†	--	--
I-95 SB Ramps	EB Right		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left	435	8.9	A	20	104	9.6	A	20	115
	WB Thru		†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	SB Left - Thru	150	89.4	F	20	30	234.0	F	83	114
	SB Right		19.1	C	64	0	18.1	C	59	48
	SB Approach		*22.8*	C	--	--	*48.1*	E	--	--
6. Route 54 (E-W) at	EB Left	435	9.6	A	15	106	9.7	A	22	108
I-95 NB Ramps	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	6	†	†	--	6
	WB Right	380	†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		9.9	A	15	0	11.1	B	30	0
	NB Approach		*9.9*	A	--	--	*11.1*	B	--	--
	SB Right		48.6	E	368	0	46.1	E	347	0
	SB Approach		*48.6*	E	--	--	*46.1*	E	--	--
7. Route 54 (E-W) at	EB Left		9.1	A	3	64	8.8	A	3	46
Telcourt Rd (N-S)	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	--	†	†	--	--
	WB Right	50	†	†	--	17	†	†	--	28
	WB Approach		†	†	--	--	†	†	--	--
	SB Left - Right		12.7	B	1	36	10.7	B	4	45
	SB Approach		*12.7*	B	--	--	*10.7*	*B*	--	--
8. Route 54 (E-W) at	EB Left	150	8.3	A	3	35	8.2	A	1	30
Mt. Hermon Rd/Frances Rd (N-S)	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	EB Right		†	†	--	--	†	†	--	2
	EB Approach		†	†	--	--	†	†	--	--
	WB Left	150	8.0	A	1	24	8.6	A	1	22
	WB Thru		†	†	--	--	†	†	--	--
	WB Right	110	†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	NB Left-Thru-Right		27.8	D	41	84	32.0	D	52	68
	NB Approach		*27.8*	D	--	--	*32.0*	D	--	--
	SB Left-Thru-Right		12.4	B	8	49	12.4	B	6	47
	SB Approach		*12.4*	B	--	--	*12.4*	B	--	--
9. Route 54 (E-W) at	EB Left	300	8.0	A	4	47	8.3	A	12	65
Woodside Ln (N-S)	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru - Right		†	†	--	2	†	†	--	2
	WB Approach		†	†	--	--	†	†	--	--
	SB Left		12.3	B	18	75	13.2	B	17	68
	SB Right	290	12.3	B	18	79	13.2	B	17	75
	SB Approach		*12.3*	B	--	--	*13.2*	*B*	--	--
10. Route 54 (E-W) at	EB Thru		†	†	--	--	†	†	--	--
Goddins Hill Rd (N-S)	EB Right	200	†	†	--	2	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left - Thru		2.8	A	6	54	1.3	A	2	44
	WB Approach		*2.8*	A	--	--	*1.3*	*A*	--	--
	NB Left - Right		12.6	B	9	54	12.1	B	14	49
	NB Approach		*12.6*	B	--	--	*12.1*	*B*	--	--
14. Site Entrance D (E-W) at	EB Left - Right		9.2	A	5	45	9.3	A	4	41
Mt. Hermon Rd (N-S)	*WB Approach*		†	†	--	--	†	†	--	--
Unsignalized	NB Thru - Left		†	†	--	--	†	†	--	--
	NB Approach		†	†	--	--	†	†	--	--
	SB Thru - Right		†	†	--	--	†	†	--	--
	SB Approach		†	†	--	--	†	†	--	--

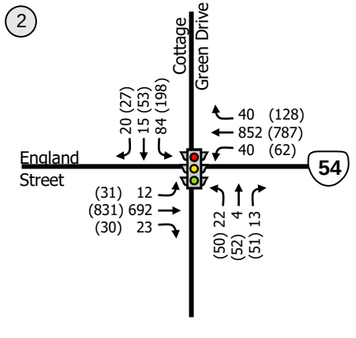
[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

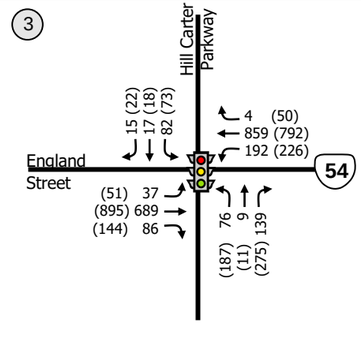
† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

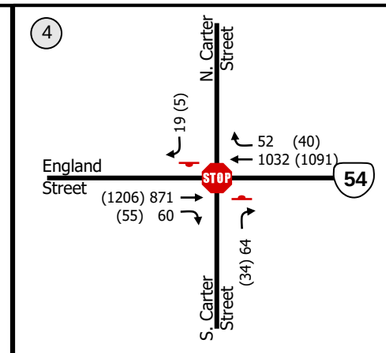
- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

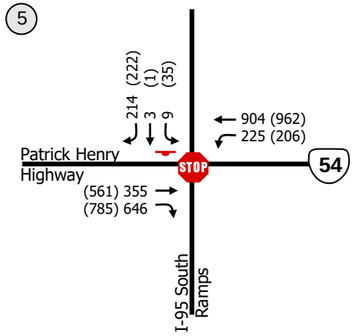
m - Volume for 95th percentile queue is metered by upstream signal.

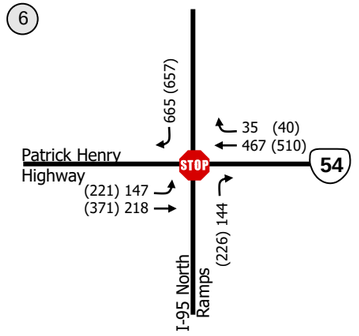


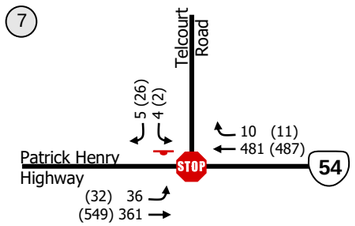


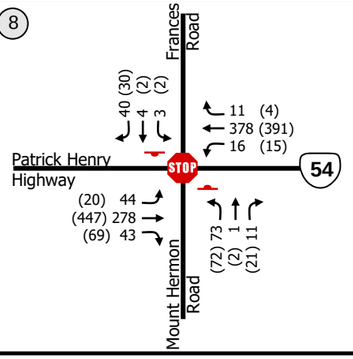


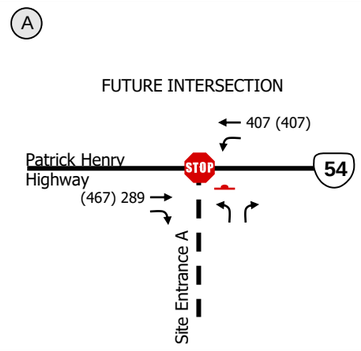


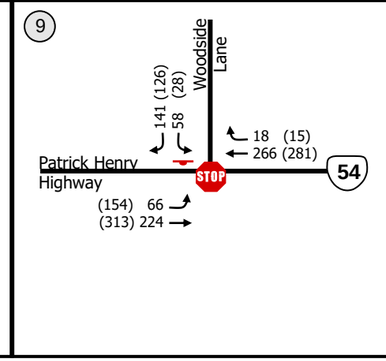


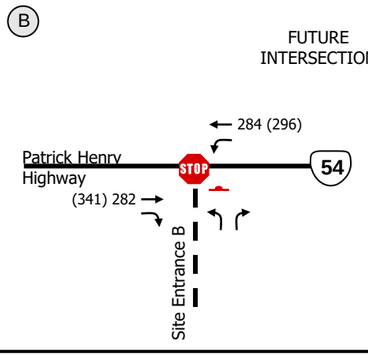


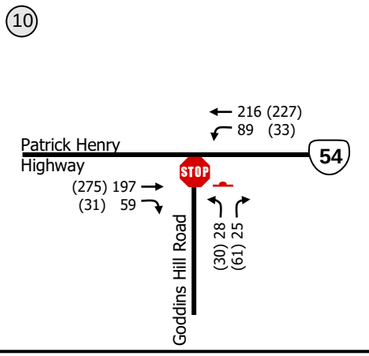






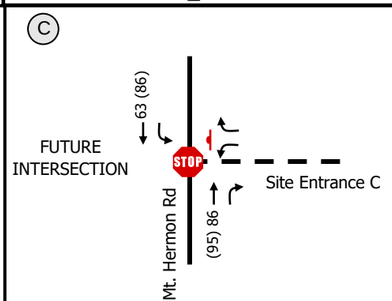


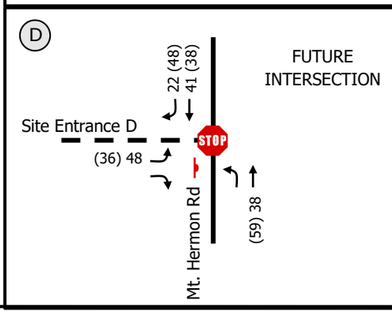




LEGEND:

- Existing Road
- Proposed Road
- XX AM Traffic Volume
- (XX) PM Traffic Volume
- Signalized Intersection
- STOP Stop Controlled Intersection





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VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
2027 Phase 1 Total Future Traffic Volumes

Figure 9-1

10 2027 TOTAL FUTURE CONDITIONS (PHASE 2)

To complete the analysis of the 2027 total conditions (with Phases 1 and 2 of the proposed development), the estimated site trips were added to the background 2027 volumes. The projected volumes were then used to complete the capacity analysis.

10.1 TOTAL FUTURE TRAFFIC VOLUMES

To generate the 2027 total future traffic volumes, the Phase 1 site trips (Figure 8-6) and the Phase 2 site trips (Figures 8-7, 8-9, and 8-11) were added to the background 2027 traffic volumes shown on Figure 5-1. The resulting 2027 (Phase 2) total future traffic volumes are shown on Figure 10-1.

10.2 2027 TOTAL FUTURE CAPACITY ANALYSES

Table 10-1 summarizes the 2027 total future intersection LOS, delay, 95th percentile (Synchro and SIDRA), and maximum (SimTraffic) queue lengths based on the 2027 total future peak hour traffic volumes shown on Figure 10-1, the Phase 2 future lane geometry (Figure 2-3), and optimized timings at the traffic signals. Note that intersections A-D are shown as numbers 11-14 in the following analysis. The corresponding SYNCHRO and SIDRA worksheets for 2027 total future analyses are included in Appendix J.

Note at Intersection #3 that the eastbound right movement is reporting excessive delay. This is an error with how Synchro is reporting delay for the intersection and may be caused by the pedestrian phase associated with the eastbound approach being turned on all the time. However, the 95th Percentile queue length is low which shows that vehicles are not waiting for the amount of time suggested by the control delay.

Note at Intersection #6 the I-95 off-ramps (SB right and NB right) are coded in Synchro as yield-controlled approaches due to the existing signs at the intersection. However, the existing lane geometry for those movements includes a receiving lane for merging traffic. As shown by the SimTraffic queue lengths (0 ft), these movements operate as free-flowing despite the HCM reports showing delay.

As shown in Table 10-1 under 2027 total future conditions (with Phases 1 and 2 of the proposed development):

- At the signalized intersection of Route 54 and Washington Highway, the overall intersection will operate at a LOS C/D during the AM/PM peaks, respectively.
    - The eastbound approach will operate at a LOS C/D during the AM/PM peaks, respectively. The EB through will operate at a LOS D during both peak hours. The westbound approach will operate at a LOS B/C during the AM/PM peaks, respectively. The WB through will operate at a LOS C/D during the AM/PM peaks, respectively.
    - The northbound left will operate at a LOS C/D during the AM/PM peaks, respectively. The NB through will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach and left movement will both operate at a LOS D during both peak hours.
    - All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Cottage Green Drive, the overall intersection will operate at a LOS A/B during the AM/PM peaks, respectively.
    - The mainline through movements will operate at a LOS B or better during both peak hours. The EB left will operate at a LOS D/E during the AM/PM peaks, respectively.

  - The northbound approach will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach will operate at a LOS D during both peak hours. The NB and SB lefts will operate at a LOS D/E during the AM/PM peaks, respectively.
  - During the PM peak, the SB left maximum queue exceeds the available storage, spiling back into the through lane. All other movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Hill Carter Parkway, the overall intersection will operate at a LOS C during both peak hours.
  - The mainline through movements will operate at a LOS C or better during both peak hours. The EB left will operate at a LOS D/C during the AM/PM peaks. The WB left will operate at a LOS D during both peak hours. As previously mentioned, the delay for the EB right is not reported correctly at this intersection.
  - The northbound approach will operate at a LOS D during both peak hours. The NB left will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach will operate at a LOS D/E during the AM/PM peaks, respectively. The SB left will operate at a LOS E during both peak hours.
  - All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the unsignalized intersection of Route 54 and I-95 SB ramp, mainline east- and westbound movements operate at a LOS B or better during both peak hours. The southbound left/through movement operates at a LOS F during both peak hours. During the PM peak, the SB left/through maximum queue fills the available storage. All other movements have adequate storage to accommodate 95th percentile and maximum queue lengths.

- At the unsignalized intersection of Route 54 and I-95 NB ramp, the mainline east- and westbound approaches operate at a LOS B during both peak hours. As previously mentioned, the north- and southbound movements report delay due to the yield-control, however the movements behave more like free-flow right turns. The NB right operates at a LOS B during both peak hours. The SB right operates at a LOS F during both peak hours. All maximum queue lengths are contained within the available storage.

- At the signalized intersection of Route 54 and Mt. Hermon Road/Frances Road, the overall intersection will operate at a LOS B during both peak hours.
  - The mainline east- and westbound movements will operate at a LOS B or better during both peak hours.
  - The northbound approach will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach will operate at a LOS C/D during the AM/PM peaks, respectively.
  - All other movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the unsignalized intersection of Route 54 with Site Entrance A, the mainline east- and westbound movements will operate at a LOS A during both peak hours. The northbound approach will operate at a LOS C/F during the AM/PM peaks, respectively. All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At all other unsignalized intersections (numbers 4, 7, 9-10, 12-14), the mainline movements (free-flowing) all operate at a LOS A during both peak hours. All side street movements (stop-controlled) operate at acceptable levels (LOS C or better) during both peak hours. All 95th percentile and maximum queue lengths are contained within the available storage.

Table 10-1: Intersection Level of Service and Delay Summary
2027 Total Future Traffic (Phase 2)

Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
1. Route 54 (E-W) at	EB Left	290	33.7	C	61	134	29.8	C	111	228
Washington Hwy (N-S)	EB Thru		36.2	D	180	246	44.2	D	232	327
Signalized	EB Right	300	30.5	C	2	127	36.7	D	0	162
	EB Approach		*34.6*	*C*	--	--	*40.0*	*D*	--	--
	WB Left		16.6	B	46	238	30.1	C	199	376
	WB Thru		26.0	C	#443	416	39.1	D	#357	541
	WB Right		0.4	A	70	0	0.3	A	0	0
	WB Approach		14.8	B	--	--	25.9	C	--	--
	NB Left	350	29.9	C	121	174	42.4	D	#230	281
	NB Thru		39.2	D	103	157	60.6	E	#260	283
	NB Right	400	0.2	A	0	0	0.2	A	0	0
	NB Approach		*24.1*	*C*	--	--	*40.0*	*D*	--	--
	SB Left	320	42.7	D	#225	291	49.9	D	#294	298
	SB Thru		42.7	D	170	248	47.9	D	230	307
	SB Right	140	35.3	D	0	139	39.7	D	0	140
	SB Approach		*41.9*	*D*	--	--	*47.6*	*D*	--	--
	Overall		**27.8**	**C**	--	--	**37.8**	**D**	--	--
2. Route 54 (E-W) at	EB Left	235	47.2	D	m13	56	69.3	E	m45	90
Cottage Green Dr (N-S)	EB Thru - Right		5.5	A	83	181	10.3	B	154	243
Signalized	*EB Approach*		*6.1*	*A*	--	--	*12.2*	*B*	--	--
	WB Dual Left	260	34.6	C	17	73	*28.7*	C	43	87
	WB Thru - Right		6.1	A	236	251	*3.3*	A	71	176
	WB Approach		*7.3*	*A*	--	--	*4.8*	*A*	--	--
	NB Left		48.2	D	39	67	*56.9*	E	79	98
	NB Thru		45.9	D	13	50	56.7	E	81	108
	NB Right	170	45.5	D	0	35	52.8	D	0	74
	NB Approach		*47.1*	*D*	--	--	*55.5*	*E*	--	--
	SB Left	155	47.7	D	100	139	56.6	E	221	154
	SB Thru - Right		42.0	D	38	85	44.4	D	85	292
	SB Approach		*46.0*	*D*	--	--	*53.1*	*D*	--	--
	Overall		**10.0**	**A**	--	--	**16.4**	**B**	--	--
3. Route 54 (E-W) at	EB Left	325	50.6	D	56	104	28.2	C	72	122
Hill Carter Pkwy (N-S)	EB Thru		13.2	B	134	342	9.5	A	82	305
Signalized	EB Right	190	21.9	C	17	188	9.3	A	4	189
	EB Approach		*15.6*	*B*	--	--	*10.3*	*B*	--	--
	WB Dual Left	550	40.0	D	97	128	*53.6*	D	135	162
	WB Thru - Right		20.4	C	223	217	*23.1*	C	267	371
	WB Approach		*23.8*	*C*	--	--	*29.1*	*C*	--	--
	NB Left	220	44.2	D	62	56	*55.4*	E	142	162
	NB Left - Thru		43.0	D	35	101	50.0	D	74	185
	NB Right	325	42.7	D	0	143	49.2	D	84	212
	NB Approach		*43.0*	*D*	--	--	*50.6*	*D*	--	--
	SB Left	290	57.3	E	100	231	*64.7*	E	107	201
	SB Thru - Right		40.5	D	20	89	50.1	D	24	56
	SB Approach		*52.5*	*D*	--	--	*59.5*	*E*	--	--
	Overall		**23.9**	**C**	--	--	**26.4**	**C**	--	--
4. Route 54 (E-W) at	EB Thru - Right		†	†	--	42	†	†	--	39
Carter Rd (N-S)	*EB Approach*		†	†	--	--	†	†	--	--
Unsignalized	WB Thru - Right		†	†	--	2	†	†	--	58
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		11.4	B	9	72	12.6	B	6	72
	NB Approach		*11.4*	B	--	--	*12.6*	B	--	--
	SB Right		11.5	B	3	58	11.4	B	1	29
	SB Approach		*11.5*	B	--	--	*11.4*	B	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.

Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
5. Route 54 (E-W) at	EB Thru		†	†	--	8	†	†	--	2
I-95 SB Ramps	EB Right		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left	435	9.7	A	29	129	10.7	B	41	170
	WB Thru		†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	SB Left - Thru	400	**	**	**	279	**	**	**	356
	SB Right		19.8	C	67	208	19.7	C	66	550
	SB Approach		*3160.3*	F	--	--	*2627.2*	F	--	--
6. Route 54 (E-W) at	EB Left	435	10.0	B	16	117	11.1	B	29	131
I-95 NB Ramps	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	12	†	†	--	9
	WB Right	380	†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		12.7	B	50	0	12.9	B	49	0
	NB Approach		*12.7*	B	--	--	*12.9*	B	--	--
	SB Right		67.5	F	443	0	99.7	F	534	0
	SB Approach		*67.5*	F	--	--	*99.7*	F	--	--
7. Route 54 (E-W) at	EB Left		9.6	A	4	67	10.3	B	4	60
Telcourt Rd (N-S)	EB Thru		†	†	--	--	†	†	--	30
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	--	†	†	--	--
	WB Right	50	†	†	--	28	†	†	--	28
	WB Approach		†	†	--	--	†	†	--	--
	SB Left - Right		15.9	C	2	35	13.0	B	5	44
	SB Approach		*15.9*	C	--	--	*13.0*	*B*	--	--
8. Route 54 (E-W) at	EB Left	150	3.6	A	m18	59	4.8	A	m11	38
Mt. Hermon Rd/Frances Rd (N-S)	EB Thru		4.9	A	148	150	7.5	A	392	188
Signalized	EB Right		0.8	A	3	74	1.3	A	2	63
	EB Approach		*3.7*	*A*	--	--	*6.1*	*A*	--	--
	WB Left	150	4.8	A	13	43	6.7	A	16	67
	WB Thru		7.3	A	222	193	11.2	B	396	251
	WB Right	110	4.7	A	2	90	6.4	A	0	37
	WB Approach		*7.1*	*A*	--	--	*11.0*	*B*	--	--
	NB Left-Thru-Right		48.3	D	161	212	58.3	E	249	288
	NB Approach		*48.3*	*D*	--	--	*58.3*	*E*	--	--
	SB Left-Thru-Right		33.2	C	32	67	35.9	D	27	49
	SB Approach		*33.2*	*C*	--	--	*35.9*	*D*	--	--
	Overall		**11.2**	**B**	--	--	**16.3**	**B**	--	--
9. Route 54 (E-W) at	EB Left	300	8.1	A	4	51	8.4	A	12	70
Woodside Ln (N-S)	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru - Right		†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	SB Left		12.5	B	19	81	13.4	B	17	53
	SB Right	290	12.5	B	19	86	13.4	B	17	85
	SB Approach		*12.5*	B	--	--	*13.4*	*B*	--	--
10. Route 54 (E-W) at	EB Thru		†	†	--	--	†	†	--	--
Goddins Hill Rd (N-S)	EB Right	200	†	†	--	2	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left - Thru		2.7	A	6	72	1.2	A	2	52
	WB Approach		*2.7*	A	--	--	*1.2*	*A*	--	--
	NB Left - Right		13.1	B	10	48	12.6	B	15	56
	NB Approach		*13.1*	B	--	--	*12.6*	*B*	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

**Delay greater than 9999.99 seconds cannot be calculated by SYNCHRO.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.

Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
11. Route 54 (E-W) at	EB Thru		†	†	--	--	†	†	--	4
Site Entrance A (N-S)	EB Right	150	†	†	--	8	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left	150	*8.5*	A	1	34	*8.8*	A	1	30
	WB Thru		†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	NB Left		19.9	C	37	101	60.3	F	177	228
	NB Right		9.7	A	0	20	10.9	B	2	25
	NB Approach		*19.5*	C	--	--	*57.2*	F	--	--
12. Route 54 (E-W) at	EB Thru - Right		†	†	--	--	†	†	--	--
Site Entrance B	*EB Approach*		†	†	--	--	†	†	--	--
Unsignalized	WB Left	300	7.9	A	1	27	8.1	A	1	26
	WB Thru		†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	NB Left - Right		10.0	A	1	30	10.6	B	2	37
	NB Approach		10.0	A	--	--	10.6	B	--	--
13. Site Entrance C (E-W) at	WB Left - Right		9.1	A	7	74	9.5	A	13	78
Mt. Hermon Rd (N-S)	*WB Approach*		†	†	--	--	†	†	--	--
Unsignalized	NB Thru-Right		†	†	--	--	†	†	--	--
	NB Approach		†	†	--	--	†	†	--	--
	SB Left - Thru		5.5	A	8	47	4.0	A	5	56
	SB Approach		†	†	--	--	†	†	--	--
14. Site Entrance D (E-W) at	EB Left - Right		9.2	A	5	49	9.3	A	4	42
Mt. Hermon Rd (N-S)	*WB Approach*		†	†	--	--	†	†	--	--
Unsignalized	NB Thru - Left		†	†	--	--	†	†	--	--
	NB Approach		†	†	--	--	†	†	--	--
	SB Thru - Right		†	†	--	--	†	†	--	--
	SB Approach		†	†	--	--	†	†	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

**Delay greater than 9999.99 seconds cannot be calculated by SYNCHRO.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.

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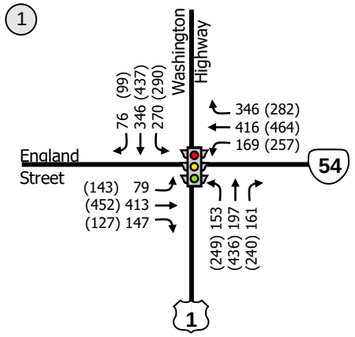
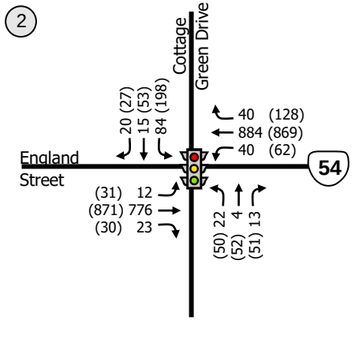
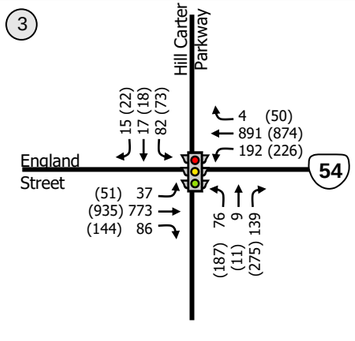
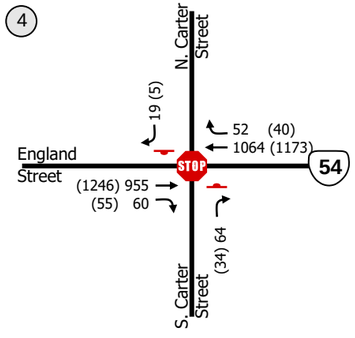
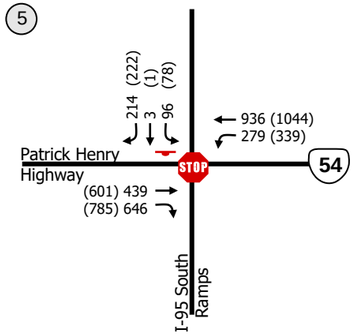
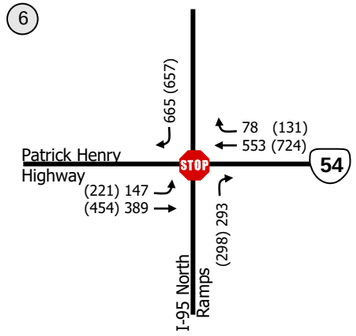


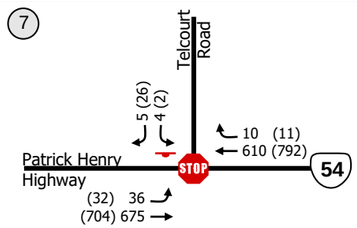


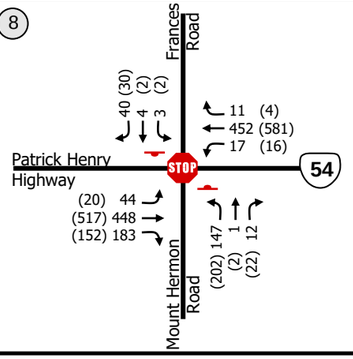


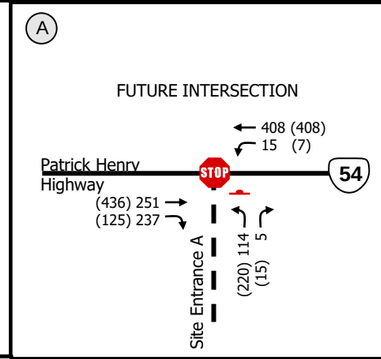


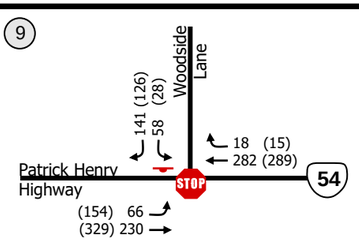


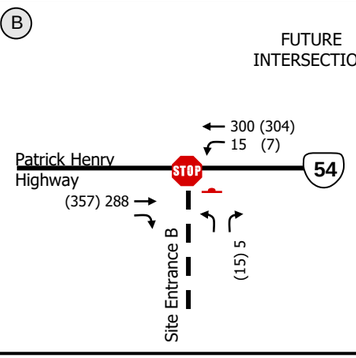


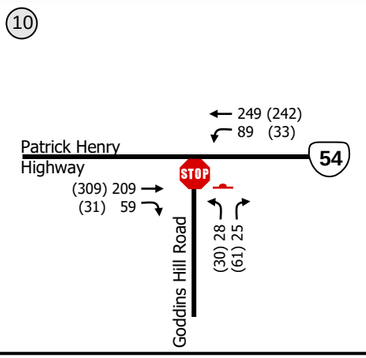






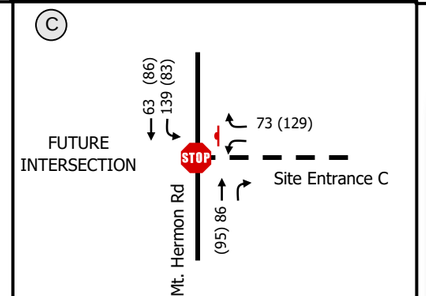


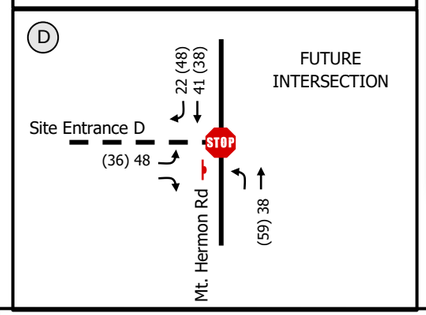




LEGEND:

- Existing Road
- Proposed Road
- XX AM Traffic Volume
- (XX) PM Traffic Volume
- Signalized Intersection
- Stop Controlled Intersection





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VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
2027 Phase 2 Total Future Traffic Volumes

Figure
10-1

11 2032 TOTAL FUTURE CONDITIONS (PHASE 3)

To complete the analysis of the 2032 total conditions (with Phases 1, 2, and 3 of the proposed development), the estimated site trips were added to the background 2032 volumes. The projected volumes were then used to complete the capacity analysis.

11.1 TOTAL FUTURE TRAFFIC VOLUMES

To generate the 2032 total future traffic volumes, the Phase 1 site trips (Figure 8-6), Phase 2 site trips (Figures 8-7, 8-9, and 8-11), and Phase 3 site trips (Figures 8-8, 8-10, and 8-12) were added to the background 2032 traffic volumes (Figure 6-1). The resulting 2032 (Phase 3) total future traffic volumes are shown on Figure 11-1.

11.2 2032 TOTAL FUTURE CAPACITY ANALYSES

Table 11-1 summarizes the 2032 total future intersection LOS, delay, 95th percentile (Synchro and SIDRA), and maximum (SimTraffic) queue lengths based on the 2032 total future peak hour traffic volumes shown on Figure 11-1, the Phase 3 future lane geometry (Figure 2-4), and optimized timings at the traffic signals. Note that intersections A-D are shown as numbers 11-14 in the following analysis. The corresponding SYNCHRO and SIDRA worksheets for 2027 total future analyses are included in Appendix K.

Note at Intersection #3 that the eastbound right movement is reporting excessive delay. This is an error with how Synchro is reporting delay for the intersection and may be caused by the pedestrian phase associated with the eastbound approach being turned on all the time. However, the 95th Percentile queue length is low which shows that vehicles are not waiting for the amount of time suggested by the control delay.

Note at Intersection #6 the I-95 off-ramps (SB right and NB right) are coded in Synchro as yield controlled approaches due to the existing signs at the intersection. However, the existing lane geometry for those movements includes a receiving lane for merging traffic. As shown by the SimTraffic queue lengths (0 ft), these movements operate as free-flowing despite the HCM reports showing delay.

As shown in Table 10-1 under 2032 total future conditions (with Phases 1, 2, and 3 of the proposed development):

- At the signalized intersection of Route 54 and Washington Highway, the overall intersection will operate at a LOS C/D during the AM/PM peaks, respectively.
    - The eastbound approach will operate at a LOS C/D during the AM/PM peaks, respectively. The westbound approach will operate at a LOS D during both peak hours. The WB through will operate at a LOS C/D during the AM/PM peaks, respectively.
    - The northbound left will operate at a LOS C/D during the AM/PM peaks, respectively. The NB through will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach and left movement will operate at a LOS D during both peak hours.
    - . All other movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Cottage Green Drive, the overall intersection will operate at a LOS A/B during the AM/PM peaks, respectively.
    - The mainline through movements will operate at a LOS B or better during both peak hours. The EB left will operate at a LOS D/E during the AM/PM peaks, respectively.
    - The northbound approach and left movement will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach will operate at a LOS D during both peak hours. The SB left will operate at a LOS D/E during the AM/PM peaks, respectively.
    - During the PM peak, the SB left maximum queue exceeds the available storage, spiling back into the through lane. All other movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Hill Carter Parkway, the overall intersection will operate at a LOS C during both peak hours.
    - The mainline through movements will operate at a LOS C or better during both peak hours. The EB and WB lefts will operate at a LOS D during both peak hours. As previously mentioned, the delay for the EB right is not reported correctly at this intersection.
    - The northbound approach will operate at a LOS D during both peak hours. The NB left will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach will operate at a LOS D/E during the AM/PM peaks, respectively. The SB left will operate at a LOS E during both peak hours.
    - All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the unsignalized intersection of Route 54 and I-95 SB ramp, the east- and westbound mainline movements operate at a LOS B or better during both peak hours. The southbound left/through movement is over capacity and operates at a LOS F during the AM/PM peaks, respectively.
    - During the PM peak, the SB left/through maximum queue fills the available storage. All other movements have adequate storage to accommodate 95th percentile and maximum queue lengths.

- At the unsignalized intersection of Route 54 and I-95 NB ramp, the mainline east- and westbound approaches operate at a LOS B or better during both peak hours. As previously mentioned, the north- and southbound movements report delay due to the yield-control, however the movements behave more like free-flow right turns. The NB right operates at a LOS B during both peak hours. The SB right operates at a LOS F during both peak hours. All maximum queue lengths are contained within the available storage.

- At the signalized intersection of Route 54 and Mt. Hermon Road/Frances Road, the overall intersection will operate at a LOS B during both peak hours.
    - The eastbound approach will operate at a LOS A during both peak hours. The westbound approach will operate at a LOS A/B during the AM/PM peaks, respectively.
    - The northbound approach will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach will operate at a LOS C/D during the AM/PM peaks, respectively.
    - All other movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the unsignalized intersection of Route 54 and Site Entrance A, the east- and westbound mainline movements will operate at a LOS A during both peak hours. The northbound approach will operate at a LOS C/F during the AM/PM peaks, respectively. All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At all other unsignalized intersections (numbers 4, 7, 9-10, 12-14), the mainline movements (free-flowing) all operate at a LOS A during both peak hours. All side street movements (stop-controlled) operate at acceptable levels (LOS C or better) during both peak hours. All 95th percentile and maximum queue lengths are contained within the available storage.

Table 11-1: Intersection Level of Service and Delay Summary
2032 Total Future Traffic

Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
1. Route 54 (E-W) at	EB Left	290	38.0	D	63	151	74.6	E	#170	272
Washington Hwy (N-S)	EB Thru		39.8	D	202	268	48.6	D	262	426
Signalized	EB Right	300	31.8	C	9	151	38.3	D	0	164
	EB Approach		*37.8*	*D*	--	--	*51.9*	*D*	--	--
	WB Left		21.1	C	129	244	33.5	C	#272	543
	WB Thru		32.4	C	#440	512	45.7	D	#612	650
	WB Right		0.5	A	74	78	0.3	A	0	168
	WB Approach		18.3	B	--	--	29.1	C	--	--
	NB Left	350	30.9	C	132	190	44.5	D	#252	295
	NB Thru		39.5	D	110	174	72.8	E	#305	342
	NB Right	400	0.2	A	0	0	0.3	A	0	0
	NB Approach		*22.6*	*C*	--	--	*45.3*	*D*	--	--
	SB Left	320	67.3	E	#381	319	67.9	E	#412	315
	SB Thru		38.6	D	176	495	50.4	D	257	484
	SB Right	140	32.8	C	0	140	40.0	D	0	140
	SB Approach		*50.2*	*D*	--	--	*55.6*	*E*	--	--
	Overall		**31.5**	**C**	--	--	**44.1**	**D**	--	--
2. Route 54 (E-W) at	EB Left	235	52.5	D	m15	61	53.7	D	m41	112
Cottage Green Dr (N-S)	EB Thru - Right		6.8	A	m142	174	15.4	B	m324	348
Signalized	*EB Approach*		*7.4*	*A*	--	--	*16.6*	*B*	--	--
	WB Dual Left	260	48.8	D	20	83	*28.1*	C	47	81
	WB Thru - Right		3.4	A	288	235	4.3	A	81	194
	WB Approach		*5.2*	*A*	--	--	*5.6*	*A*	--	--
	NB Left		48.2	D	40	68	*57.5*	E	84	105
	NB Thru		45.9	D	14	46	57.4	E	87	116
	NB Right	170	45.4	D	0	41	52.9	D	0	79
	NB Approach		*47.0*	*D*	--	--	*55.9*	*E*	--	--
	SB Left	155	48.5	D	107	134	56.4	E	235	154
	SB Thru - Right		41.7	D	40	100	43.6	D	89	330
	SB Approach		*46.5*	*D*	--	--	*52.8*	*D*	--	--
	Overall		**9.3**	**A**	--	--	**17.8**	**B**	--	--
3. Route 54 (E-W) at	EB Left	325	50.8	D	50	122	30.1	C	m78	119
Hill Carter Pkwy (N-S)	EB Thru		16.8	B	239	374	9.7	A	98	493
Signalized	EB Right	190	22.2	C	16	190	4.2	A	4	190
	EB Approach		*18.5*	*B*	--	--	*9.9*	*A*	--	--
	WB Dual Left	550	33.8	C	107	140	*62.4*	E	136	166
	WB Thru - Right		14.5	B	264	234	*17.9*	B	156	313
	WB Approach		*17.8*	*B*	--	--	*25.9*	*C*	--	--
	NB Left	220	43.8	D	63	67	*55.0*	D	150	150
	NB Left - Thru		42.6	D	36	113	49.4	D	78	183
	NB Right	325	42.4	D	0	183	48.6	D	85	256
	NB Approach		*42.7*	*D*	--	--	*50.1*	*D*	--	--
	SB Left	290	57.2	E	105	222	*76.5*	E	#126	196
	SB Thru - Right		39.9	D	20	68	50.7	D	27	46
	SB Approach		*52.3*	*D*	--	--	*67.3*	*E*	--	--
	Overall		**21.9**	**C**	--	--	**25.0**	**C**	--	--
4. Route 54 (E-W) at	EB Thru - Right		†	†	--	105	†	†	--	143
Carter Rd (N-S)	*EB Approach*		†	†	--	--	†	†	--	--
Unsignalized	WB Thru - Right		†	†	--	7	†	†	--	29
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		12.3	B	11	82	13.4	B	7	74
	NB Approach		*12.3*	B	--	--	*13.4*	B	--	--
	SB Right		12.1	B	3	59	12.2	B	1	29
	SB Approach		*12.1*	B	--	--	*12.2*	B	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.

Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
5. Route 54 (E-W) at	EB Thru		10.1	B	79	209	18.0	B	131	286
I-95 SB Ramps	EB Right		1.3	A	446	0	1.3	A	675	0
Signalized	*EB Approach*		5.3	A	--	--	8.9	A	--	--
	WB Left	435	12.8	B	m193	270	17.0	B	m328	583
	WB Thru		9.2	A	263	232	6.6	A	m312	376
	WB Approach		10.1	B	--	--	9.8	A	--	--
	SB Left - Thru	400	48.5	D	227	279	57.6	E	173	244
	SB Right		0.3	A	0	0	0.2	A	0	0
	SB Approach		*24.3*	C	--	--	*21.8*	C	--	--
	Overall		**10.2**	**B**	--	--	**10.6**	**B**	--	--
6. Route 54 (E-W) at	EB Left	435	11.3	B	22	146	15.5	C	52	288
I-95 NB Ramps	EB Thru		†	†	--	--	†	†	--	98
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	4	†	†	--	27
	WB Right	380	†	†	--	26	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		15.6	C	113	0	11.9	B	61	0
	NB Approach		*15.6*	C	--	--	*11.9*	B	--	--
	SB Right		156.0	F	745	0	306.1	F	1039	0
	SB Approach		*156.0*	F	--	--	*306.1*	F	--	--
7. Route 54 (E-W) at	EB Left		10.9	B	5	79	13.9	B	7	85
Telcourt Rd (N-S)	EB Thru		†	†	--	208	†	†	--	223
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	6	†	†	--	--
	WB Right	50	†	†	--	30	†	†	--	28
	WB Approach		†	†	--	--	†	†	--	--
	SB Left - Right		26.9	D	5	46	20.1	C	10	76
	SB Approach		*26.9*	D	--	--	*20.1*	*C*	--	--
8. Route 54 (E-W) at	EB Left	150	7.2	A	m20	148	25.1	C	m14	87
Mt. Hermon Rd/Frances Rd (N-S)	EB Thru		15.9	B	566	460	17.6	B	249	572
Signalized	EB Right		2.8	A	6	118	7.1	A	13	105
	EB Approach		11.1	B	--	--	14.8	B	--	--
	WB Left	150	7.2	A	m9	112	13.6	B	m11	106
	WB Thru		13.1	B	330	340	54.1	D	#1054	786
	WB Right	110	9.1	A	m0	77	13.3	B	m0	60
	WB Approach		12.8	B	--	--	53.0	D	--	--
	NB Left-Thru-Right		58.1	E	#329	363	86.2	F	#589	431
	NB Approach		*58.1*	E	--	--	*86.2*	F	--	--
	SB Left-Thru-Right		25.9	C	31	69	25.3	C	26	50
	SB Approach		*25.9*	C	--	--	*25.3*	C	--	--
	Overall		**18.3**	**B**	--	--	**43.0**	**D**	--	--
9. Route 54 (E-W) at	EB Left	300	8.2	A	5	55	8.5	A	13	76
Woodside Ln (N-S)	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru - Right		†	†	--	2	†	†	--	7
	WB Approach		†	†	--	--	†	†	--	--
	SB Left		13.6	B	22	81	15.0	B	20	61
	SB Right	290	13.6	B	22	88	15.0	B	20	81
	SB Approach		*13.6*	B	--	--	*15.0*	*B*	--	--
10. Route 54 (E-W) at	EB Thru		†	†	--	--	†	†	--	--
Goddins Hill Rd (N-S)	EB Right	200	†	†	--	12	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left - Thru		2.6	A	7	77	1.2	A	3	62
	WB Approach		*2.6*	A	--	--	*1.2*	*A*	--	--
	NB Left - Right		14.7	B	12	56	14.0	B	20	63
	NB Approach		*14.7*	B	--	--	*14.0*	*B*	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.

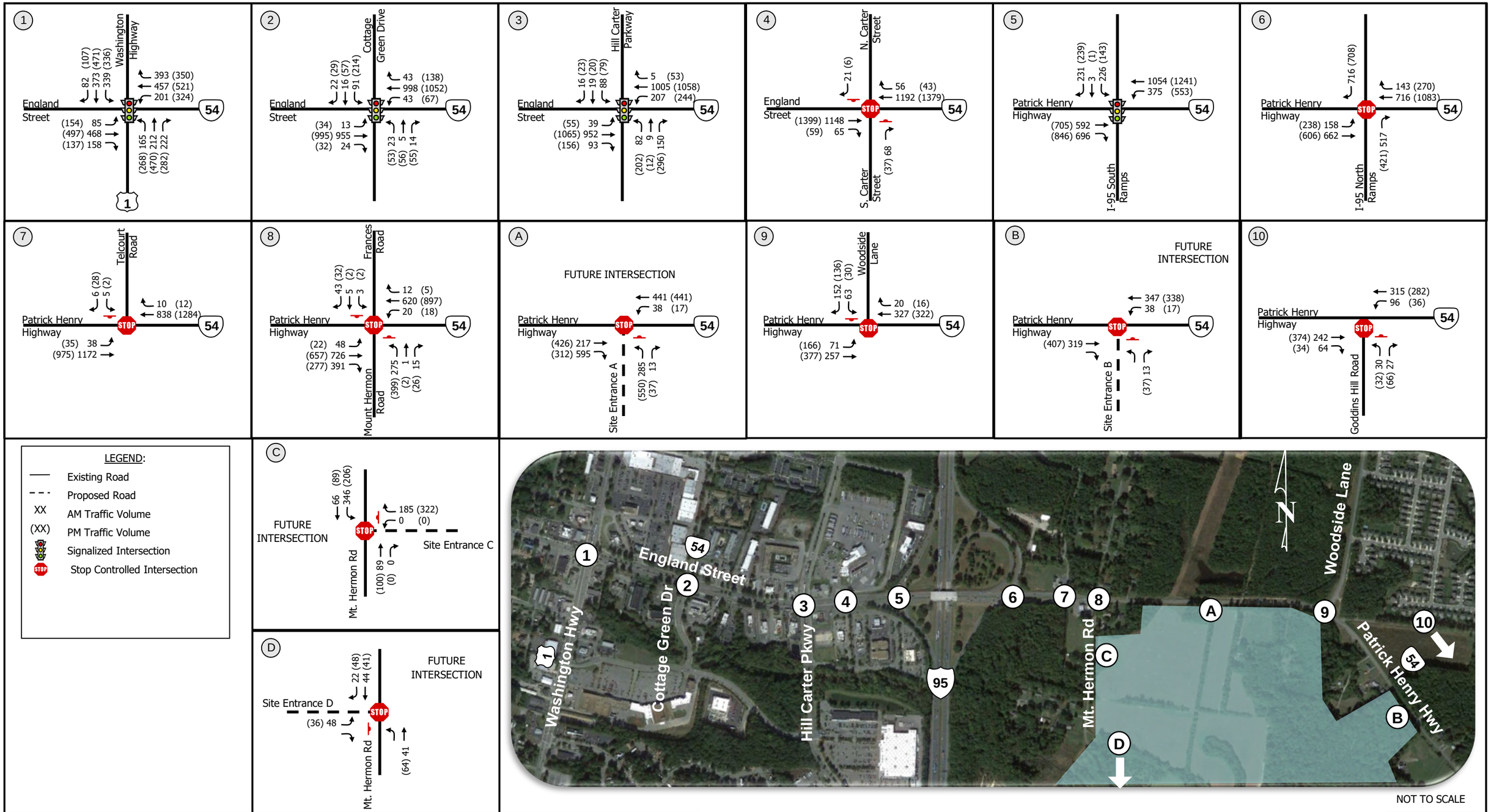
Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
11. Route 54 (E-W) at	EB Thru		*4.1*	A	m25	145	*9.8*	A	m458	408
Site Entrance A (N-S)	EB Right	150	*3.5*	A	m0	137	*10.3*	B	m168	150
Signalized	*EB Approach*		*3.7*	A	--	--	*10.0*	A	--	--
	WB Left	150	*7.6*	A	28	120	*16.2*	B	23	121
	WB Thru		*10.8*	B	261	258	*23.1*	C	392	329
	WB Approach		*10.6*	B	--	--	*22.8*	C	--	--
	NB Left		45.1	D	256	366	47.4	D	531	572
	NB Right		28.9	C	14	25	22.4	C	20	47
	NB Approach		*44.4*	D	--	--	*45.8*	D	--	--
	Overall		**13.4**	**B**	--	--	**25.1**	**C**	--	--
12. Route 54 (E-W) at	EB Thru - Right		†	†	--	--	†	†	--	--
Site Entrance B	*EB Approach*		†	†	--	--	†	†	--	--
Unsignalized	WB Left	300	8.0	A	3	34	8.2	A	1	37
	WB Thru		†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	NB Left - Right		10.2	B	2	31	11.2	B	5	46
	NB Approach		10.2	B	--	--	11.2	B	--	--
13. Site Entrance C (E-W) at	WB Left - Right		9.8	A	20	102	11.1	B	44	122
Mt. Hermon Rd (N-S)	*WB Approach*		†	†	--	--	†	†	--	--
Unsignalized	NB Thru-Right		†	†	--	--	†	†	--	--
	NB Approach		†	†	--	--	†	†	--	--
	SB Left - Thru		7.3	A	25	68	5.9	A	14	68
	SB Approach		†	†	--	--	†	†	--	--
14. Site Entrance D (E-W) at	EB Left - Right		9.3	A	5	48	9.4	A	4	48
Mt. Hermon Rd (N-S)	*WB Approach*		†	†	--	--	†	†	--	--
Unsignalized	NB Thru - Left		†	†	--	--	†	†	--	--
	NB Approach		†	†	--	--	†	†	--	--
	SB Thru - Right		†	†	--	--	†	†	--	--
	SB Approach		†	†	--	--	†	†	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.



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VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
2032 Phase 3 Total Future Traffic Volumes

Figure
11-1

12 2038 TOTAL FUTURE CONDITIONS

To complete the analysis of the 2038 total conditions (with Phases 1, 2, and 3 of the proposed development), the estimated site trips were added to the background 2038 volumes. The projected volumes were then used to complete the capacity analysis.

12.1 TOTAL FUTURE TRAFFIC VOLUMES

To generate the 2038 total future traffic volumes, the Phase 1 site trips (Figure 8-6), Phase 2 site trips (Figures 8-7, 8-9, and 8-11), and Phase 3 site trips (Figures 8-8, 8-10, and 8-12) were added to the background 2038 traffic volumes shown on Figure 7-1. The resulting 2038 total future traffic volumes are shown on Figure 12-1.

12.2 2038 TOTAL FUTURE CAPACITY ANALYSES

Table 12-1 summarizes the 2038 total future intersection LOS, delay, 95th percentile (Synchro and SIDRA), and maximum (SimTraffic) queue lengths based on the 2038 total future peak hour traffic volumes shown on Figure 12-1, the Phase 3 future lane geometry (Figure 2-4), and optimized timings at the traffic signals. Note that intersections A-D are shown as numbers 11-14 in the following analysis. The corresponding SYNCHRO and SIDRA worksheets for 2027 total future analyses are included in Appendix L.

Note at Intersection #3 that the eastbound right movement is reporting excessive delay. This is an error with how Synchro is reporting delay for the intersection and may be caused by the pedestrian phase associated with the eastbound approach being turned on all the time. However, the 95th Percentile queue length is low which shows that vehicles are not waiting for the amount of time suggested by the control delay.

Note at Intersection #6 the I-95 off-ramps (SB right and NB right) are coded in Synchro as yield controlled approaches due to the existing signs at the intersection. However, the existing lane geometry for those movements includes a receiving lane for merging traffic. As shown by the SimTraffic queue lengths (0 ft), these movements operate as free-flowing despite the HCM reports showing delay.

As shown in Table 11-1 under 2038 total future conditions:

- At the signalized intersection of Route 54 and Washington Highway, the overall intersection will operate at a LOS D/E during the AM/PM peaks, respectively.
    - The eastbound approach will operate at a LOS D during both peak hours. The EB left will operate at a LOS C/F during the AM/PM peaks, respectively. The westbound approach will operate at a LOS C/D during the AM/PM peaks, respectively. The WB through will operate at a LOS D/E during the AM/PM peaks, respectively.
    - The northbound left will operate at a LOS C/F during the AM/PM peaks, respectively. The NB through will operate at a LOS D/F during the AM/PM peaks, respectively. The southbound approach will operate at a LOS D/E during both peak hours. The SB left will operate at a LOS E/F during the AM/PM peaks, respectively.
    - During the PM peak: the WB through maximum queue backs up to Cottage Green Dr. The EB through maximum queue backs up through the intersection with Louisiana St. The NB left maximum queue exceeds the available storage, spilling into the through lanes and backing up through the intersection with Myrtle Ave. During both peak hours, the SB left maximum queue exceeds the available storage, spilling into the through lanes and backing up through the intersection with College Ave.
    - All other movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Cottage Green Drive, the overall intersection will operate at a LOS B during both peak hours.
    - The mainline through movements will operate at a LOS B or better during both peak hours. The EB left will operate at a LOS D/E during the AM/PM peaks, respectively. The WB left will operate at a LOS E/C during the AM/PM peaks, respectively.
    - The northbound approach will operate at a LOS D/E during the AM/PM peaks, respectively. The southbound approach will operate at a LOS D during both peak hours.
    - During the PM peak, the SB left maximum queue exceeds the available storage, spiling back into the through lane. All other movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Hill Carter Parkway, the overall intersection will operate at a LOS C during both peak hours.
    - The mainline through movements will operate at a LOS C or better during both peak hours. The EB left will operate at a LOS D/C during the AM/PM peaks, respectively. The WB left will operate at a LOS C/E during the AM/PM peaks, respectively. As previously mentioned, the delay for the EB right is not reported correctly at this intersection.
    - The northbound approach and left movement will operate at a LOS D during both peak hours. The southbound approach will operate at a LOS D/E during the AM/PM peaks, respectively. The SB left will operate at a LOS E during both peak hours.
    - All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and I-95 SB ramp, the overall intersection will operate at a LOS B during both peak hours.
    - The mainline movements all operate at a LOS C or better during both peak hours. The southbound left/through movement operates at a LOS D/E during the AM/PM peaks, respectively.
    - During both peak hours, the WB left maximum queue exceeds the available storage, spilling back into through lanes. All other movements have adequate storage to accommodate 95th percentile and maximum queue lengths.

- At the unsignalized intersection of Route 54 and I-95 NB ramp, the mainline east- and westbound approaches operate at a LOS C or better during both peak hours. As previously mentioned, the north- and southbound movements report delay due to the yield-control, however the movements behave more like free-flow right turns. The NB right operates at a LOS C or better during both peak hours. The SB right operates at a LOS F during both peak hours. All maximum queue lengths are contained within the available storage.

- At the signalized intersection of Route 54 and Mt. Hermon Road/Frances Road, the overall intersection will operate at a LOS B/D during the AM/PM peaks, respectively.
    - The eastbound approach will operate at a LOS B during both peak hours. The westbound approach will operate at a LOS B/D during the AM/PM peaks, respectively. The WB through will operate at a LOS D during the PM peak.
    - The northbound approach will operate at a LOS E/F during the AM/PM peaks, respectively. The southbound approach will operate at a LOS C during both peak hours.
    - During both peak hours, the EB through maximum queue will back up through the intersection of Telcourt Rd. All other movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At the signalized intersection of Route 54 and Site Entrance A, the overall intersection will operate at a LOS B/C during the AM/PM peaks, respectively.
    - All mainline movements will operate at a LOS C or better during both peak hours. The northbound approach will operate at a LOS D during both peak hours. All movements have adequate turn bay storage to accommodate 95th percentile and maximum queue lengths.

- At all other unsignalized intersections (numbers 4, 7, 9-10, 12-14), the mainline movements (free-flowing) all operate at a LOS B or better during both peak hours. All side street movements (stop-controlled) operate at acceptable levels (LOS C or better) during both peak hours except the SB approaches on Woodside Ln and Providence Church Rd will operate at a LOS D during the PM peak hour. All 95th percentile and maximum queue lengths are contained within the available storage.

Table 11-1: Intersection Level of Service and Delay Summary
2038 Total Future Traffic

Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
1. Route 54 (E-W) at	EB Left	290	33.0	C	#81	190	116.2	F	#237	271
Washington Hwy (N-S)	EB Thru		42.6	D	223	261	46.7	D	277	439
Signalized	EB Right	300	32.3	C	19	119	36.6	D	21	248
	EB Approach		*39.1*	*D*	--	--	*58.6*	*E*	--	--
	WB Left		23.3	C	#189	304	48.4	D	#335	756
	WB Thru		52.0	D	#550	536	56.1	E	#693	848
	WB Right		0.5	A	86	147	0.4	A	0	484
	WB Approach		27.3	C	--	--	37.8	D	--	--
	NB Left	350	32.2	C	142	205	80.3	F	#340	350
	NB Thru		39.9	D	119	170	99.0	F	#351	834
	NB Right	400	0.3	A	0	0	0.3	A	0	120
	NB Approach		*23.4*	*C*	--	--	*67.1*	*E*	--	--
	SB Left	320	75.3	E	#334	320	105.9	F	#476	320
	SB Thru		38.0	D	189	725	52.6	D	278	808
	SB Right	140	31.8	C	0	140	39.7	D	0	140
	SB Approach		*53.1*	*D*	--	--	*70.5*	*E*	--	--
	Overall		**35.7**	**D**	--	--	**57.3**	**E**	--	--
2. Route 54 (E-W) at	EB Left	235	37.5	D	m15	61	58.3	E	m47	94
Cottage Green Dr (N-S)	EB Thru - Right		9.6	A	m148	218	16.7	B	m317	373
Signalized	*EB Approach*		*9.9*	*A*	--	--	*18.0*	*B*	--	--
	WB Dual Left	260	55.2	E	m23	75	*28.6*	C	m48	115
	WB Thru - Right		3.8	A	313	239	*4.8*	A	128	214
	WB Approach		*5.9*	*A*	--	--	*6.1*	*A*	--	--
	NB Left		48.5	D	43	74	*58.6*	E	90	113
	NB Thru		45.8	D	14	53	58.5	E	94	106
	NB Right	170	45.3	D	0	42	52.8	D	0	86
	NB Approach		*47.1*	*D*	--	--	*56.6*	*E*	--	--
	SB Left	155	44.7	D	112	148	56.7	E	254	154
	SB Thru - Right		40.2	D	42	114	42.8	D	96	317
	SB Approach		*43.3*	*D*	--	--	*52.7*	*D*	--	--
	Overall		**10.6**	**B**	--	--	**18.7**	**B**	--	--
3. Route 54 (E-W) at	EB Left	325	48.2	D	50	131	29.6	C	m78	158
Hill Carter Pkwy (N-S)	EB Thru		19.7	B	307	422	11.7	B	111	690
Signalized	EB Right	190	22.6	C	21	190	4.0	A	5	190
	EB Approach		*21.0*	*C*	--	--	*11.6*	*B*	--	--
	WB Dual Left	550	33.4	C	115	139	*72.2*	E	#173	198
	WB Thru - Right		15.1	B	288	242	*20.3*	C	191	376
	WB Approach		*18.2*	*B*	--	--	*29.7*	*C*	--	--
	NB Left	220	43.9	D	70	73	55.0	D	162	152
	NB Left - Thru		42.5	D	39	118	48.7	D	83	184
	NB Right	325	42.3	D	0	187	49.3	D	118	277
	NB Approach		*42.6*	*D*	--	--	*50.3*	*D*	--	--
	SB Left	290	60.4	E	113	228	*67.1*	*E*	#140	240
	SB Thru - Right		39.7	D	21	97	49.2	D	28	55
	SB Approach		*54.5*	*D*	--	--	*60.7*	*E*	--	--
	Overall		**23.3**	**C**	--	--	**27.0**	**C**	--	--
4. Route 54 (E-W) at	EB Thru - Right		†	†	--	133	†	†	--	159
Carter Rd (N-S)	*EB Approach*		†	†	--	--	†	†	--	--
Unsignalized	WB Thru - Right		†	†	--	10	†	†	--	71
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		12.9	B	13	86	14.2	B	9	77
	NB Approach		*12.9*	B	--	--	*14.2*	B	--	--
	SB Right		12.6	B	4	68	12.7	B	1	27
	SB Approach		*12.6*	B	--	--	*12.7*	B	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.

Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
5. Route 54 (E-W) at	EB Thru		10.5	B	103	243	15.8	B	181	301
I-95 SB Ramps	EB Right		1.5	A	494	0	1.5	A	681	0
Signalized	*EB Approach*		*5.6*	*A*	--	--	*8.0*	*A*	--	--
	WB Left	435	13.9	B	m229	413	22.0	C	m364	733
	WB Thru		10.0	A	301	344	7.4	A	m310	486
	WB Approach		*11.0*	*B*	--	--	*11.8*	*B*	--	--
	SB Left - Thru	400	48.8	D	228	288	60.5	E	181	252
	SB Right		0.3	A	0	0	0.3	*A*	0	0
	SB Approach		*23.5*	*C*	--	--	*22.0*	C	--	--
	Overall		**10.6**	**B**	--	--	**11.2**	**B**	--	--
6. Route 54 (E-W) at	EB Left	435	11.9	B	26	177	17.3	C	65	367
I-95 NB Ramps	EB Thru		†	†	--	3	†	†	--	290
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	10	†	†	--	17
	WB Right	380	†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	NB Right		15.2	C	113	0	12.5	B	69	0
	NB Approach		*15.2*	*C*	--	--	*12.5*	*B*	--	--
	SB Right		227.2	F	991	0	402.3	F	1287	0
	SB Approach		*227.2*	*F*	--	--	*402.3*	*F*	--	--
7. Route 54 (E-W) at	EB Left		11.3	B	6	88	14.5	B	8	92
Telcourt Rd (N-S)	EB Thru		†	†	--	194	†	†	--	351
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru		†	†	--	--	†	†	--	9
	WB Right	50	†	†	--	25	†	†	--	28
	WB Approach		†	†	--	--	†	†	--	--
	SB Left - Right		29.5	D	6	57	24.0	C	14	70
	SB Approach		*29.5*	*D*	--	--	*24.0*	*C*	--	--
8. Route 54 (E-W) at	EB Left	150	8.7	A	m23	141	26.3	C	m15	140
Mt. Hermon Rd/Frances Rd (N-S)	EB Thru		18.2	B	#631	449	15.9	B	251	898
Signalized	EB Right		4.1	A	11	147	5.4	A	12	94
	EB Approach		*13.2*	*B*	--	--	*13.2*	*B*	--	--
	WB Left	150	8.8	A	m11	138	12.6	B	m12	127
	WB Thru		15.5	B	357	383	49.6	D	#1116	925
	WB Right	110	9.3	A	m0	77	12.0	B	m0	35
	WB Approach		*15.2*	*B*	--	--	*48.7*	*D*	--	--
	NB Left-Thru-Right		58.3	E	#339	319	120.0	F	#629	462
	NB Approach		*58.3*	*E*	--	--	*120.0*	*F*	--	--
	SB Left-Thru-Right		25.7	C	32	72	27.3	C	30	78
	SB Approach		*25.7*	*C*	--	--	*27.3*	*C*	--	--
	Overall		**20.0**	**B**	--	--	**46.3**	**D**	--	--
9. Route 54 (E-W) at	EB Left	300	8.3	A	6	52	8.7	A	15	93
Woodside Ln (N-S)	EB Thru		†	†	--	--	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Thru - Right		†	†	--	8	†	†	--	13
	WB Approach		†	†	--	--	†	†	--	--
	SB Left		14.6	B	26	81	16.8	C	24	68
	SB Right	290	14.6	B	26	99	16.8	C	24	88
	SB Approach		*14.6*	B	--	--	*16.8*	*C*	--	--
10. Route 54 (E-W) at	EB Thru		†	†	--	--	†	†	--	--
Goddins Hill Rd (N-S)	EB Right	200	†	†	--	11	†	†	--	--
Unsignalized	*EB Approach*		†	†	--	--	†	†	--	--
	WB Left - Thru		2.7	A	8	95	1.3	A	3	65
	WB Approach		†	†	--	--	†	†	--	--
	NB Left - Right		15.8	C	15	69	15.1	C	24	69
	NB Approach		*15.8*	C	--	--	*15.1*	*C*	--	--

[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

m - Volume for 95th percentile queue is metered by upstream signal.

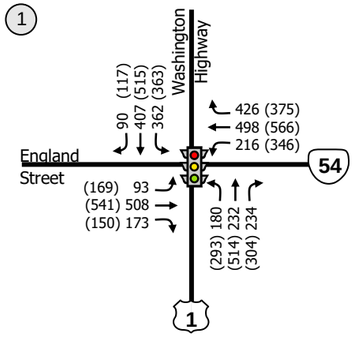
Intersection and Type of Control	Movement and Approach	Turn Lane Storage (ft)	AM PEAK HOUR				PM PEAK HOUR			
			Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)	Delay [1] (sec/veh)	LOS [1]	HCS 95th Percentile Queue Length (ft)	Simulated Maximum Queue Length (ft)
11. Route 54 (E-W) at	EB Thru		4.9	A	m30	138	12.9	B	m522	524
Site Entrance A (N-S)	EB Right	150	4.6	A	m0	138	14.1	B	m111	150
Signalized	*EB Approach*		*4.7*	*A*	--	--	*13.4*	*B*	--	--
	WB Left	150	7.7	A	28	137	16.4	B	24	130
	WB Thru		11.3	B	293	259	24.3	C	445	400
	WB Approach		*11.1*	*B*	--	--	*24.1*	*C*	--	--
	NB Left		45.1	D	256	355	47.0	D	525	691
	NB Right		28.9	C	14	27	22.3	C	20	222
	NB Approach		*44.4*	*D*	--	--	*45.5*	*D*	--	--
	Overall		**13.8**	**B**	--	--	**26.3**	**C**	--	--
12. Route 54 (E-W) at	EB Thru - Right		†	†	--	--	†	†	--	--
Site Entrance B	*EB Approach*		†	†	--	--	†	†	--	--
Unsignalized	WB Left	300	8.1	A	3	36	8.3	A	1	32
	WB Thru		†	†	--	--	†	†	--	--
	WB Approach		†	†	--	--	†	†	--	--
	NB Left - Right		10.5	B	2	31	11.5	B	5	44
	NB Approach		10.5	B	--	--	11.5	B	--	--
13. Site Entrance C (E-W) at	WB Left - Right		9.9	A	20	90	11.2	B	44	118
Mt. Hermon Rd (N-S)	*WB Approach*		†	†	--	--	†	†	--	--
Unsignalized	NB Thru-Right		†	†	--	--	†	†	--	--
	NB Approach		†	†	--	--	†	†	--	--
	SB Left - Thru		7.2	A	25	67	5.9	A	14	72
	SB Approach		†	†	--	--	†	†	--	--
14. Site Entrance D (E-W) at	EB Left - Right		9.3	A	5	43	9.5	A	4	43
Mt. Hermon Rd (N-S)	*WB Approach*		†	†	--	--	†	†	--	--
Unsignalized	NB Thru - Left		†	†	--	--	†	†	--	--
	NB Approach		†	†	--	--	†	†	--	--
	SB Thru - Right		†	†	--	--	†	†	--	--
	SB Approach		†	†	--	--	†	†	--	--

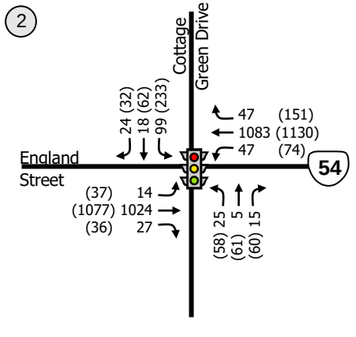
[1] Overall intersection LOS and delay reported for signalized intersections and roundabouts only.

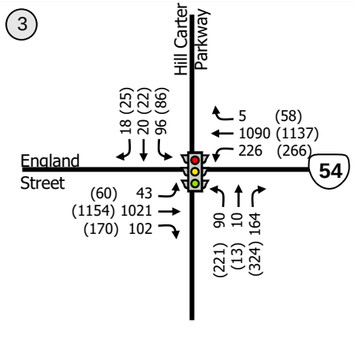
† SYNCHRO does not provide level of service or delay for unsignalized movements with no conflicting volumes.

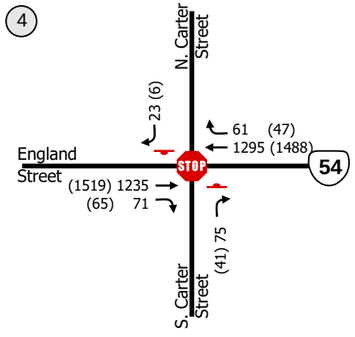
- 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

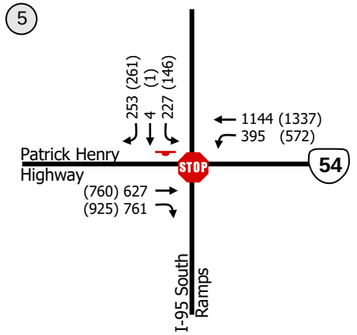
m - Volume for 95th percentile queue is metered by upstream signal.

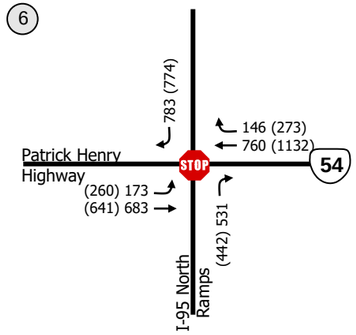


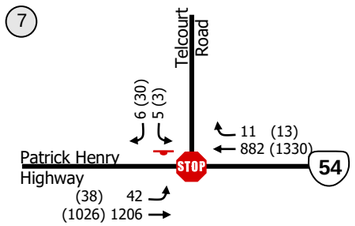


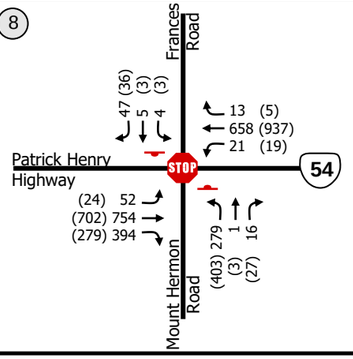


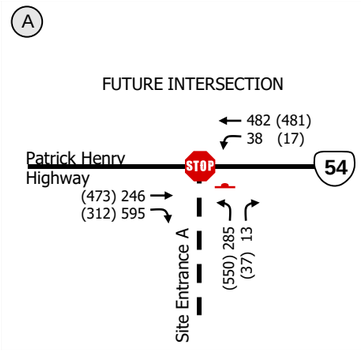


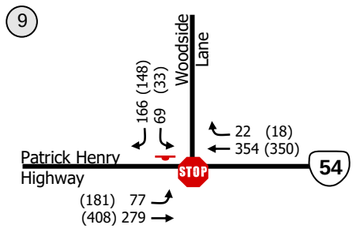


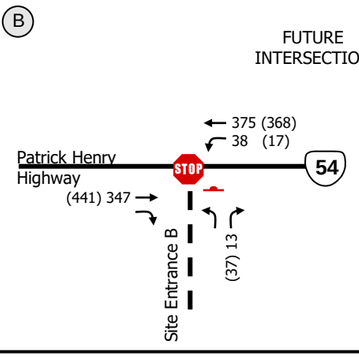


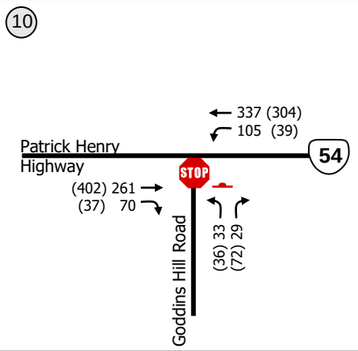






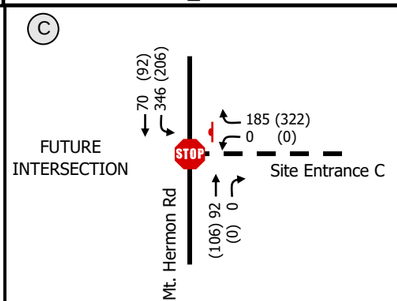


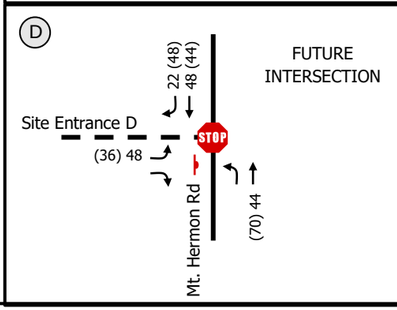


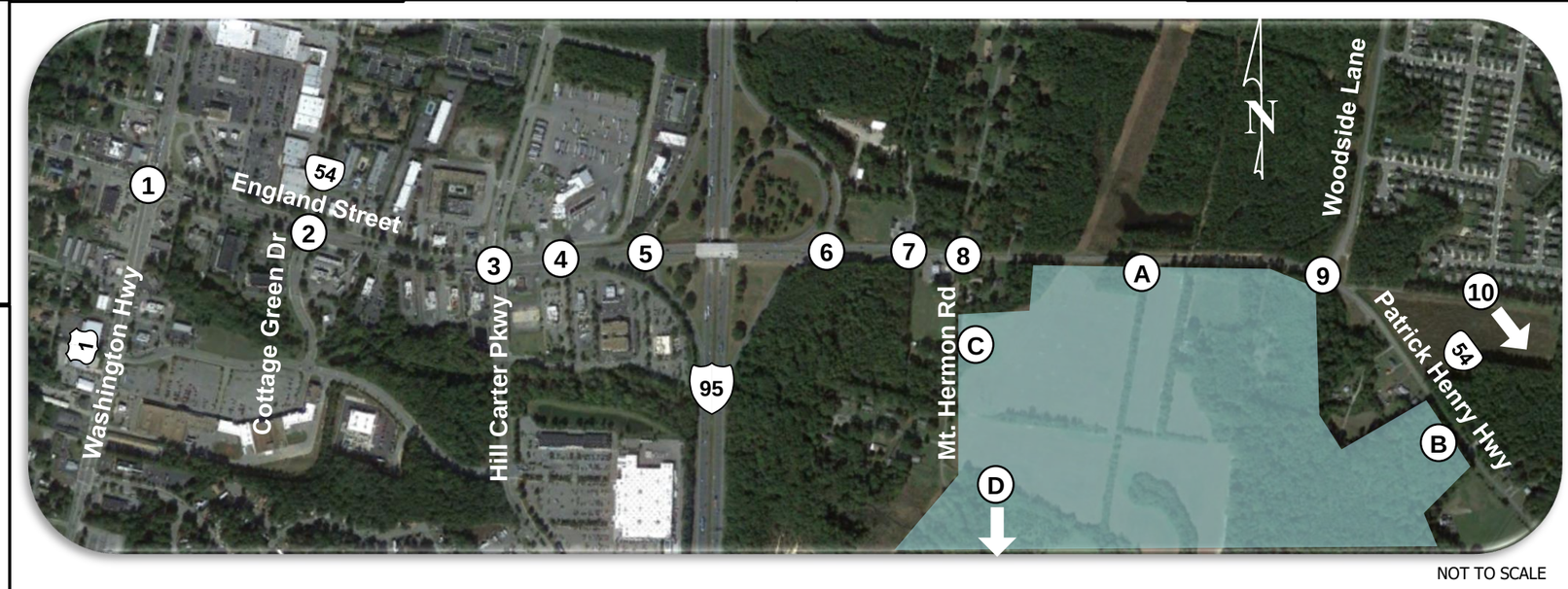


LEGEND:

- Existing Road
- Proposed Road
- XX AM Traffic Volume
- (XX) PM Traffic Volume
- Signalized Intersection
- Stop Controlled Intersection







NOT TO SCALE

TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

VDOT Chapter 527 TIA
Iron Horse Business Center Rezoning
2038 Total Future Traffic Volumes

Figure
12-1

13 ADDITIONAL ANALYSIS

The goal of the following chapter is to provide an analysis of potential improvements within the study area that may impact the analysis or recommendations for the Iron Horse Business Park.

13.1 Turn Lane Warrant Analysis

The study area includes multiple unsignalized intersections that currently do not have turn lanes. To gauge the impacts of the proposed site trips on the existing roadway network, turn lane warrant analyses were completed for the following movements with the 2027 (Phase 1) total traffic volumes:

1. EB Right on Route 54 at Mt. Hermon Road;
2. and WB Left on Route 54 at Mt. Hermon Road.

Turn lane warrant analyses were completed for the following movements with the 2027 (Phase 2) total traffic volumes:

3. EB Right on Route 54 at Site Entrance "A";
4. WB Left on Route 54 at Site Entrance "A";
5. EB Right on Route 54 at Site Entrance "B";
6. WB Left on Route 54 at Site Entrance "B";
7. SB Left on Mt. Hermon Road at Site Entrance "C";
8. and NB Right on Mt. Hermon Road at Site Entrance "C".

Turn lane warrant analyses were completed for the following movements with the 2032 (Phase 3) total traffic volumes:

9. EB Right on Route 54 at Site Entrance "B";
10. WB Left on Route 54 at Site Entrance "B";
11. SB Left on Mt. Hermon Road at Site Entrance "C";
12. and NB Right on Mt. Hermon Road at Site Entrance "C".

The appropriate right and left turn lane warrant nomographs from Appendix F of the VDOT *Road Design Manual* were used to complete the turn lane warrant analyses for each of the listed movements.

The turn lane warrant analysis indicates that turn lanes are warranted for the following movements under 2027 total conditions (with Phase 1 of the proposed development):

1. EB Right on Route 54 at Mt. Hermon Road (100' storage with 100' taper);
2. and WB Left on Route 54 at Mt. Hermon Road (100' storage with 100' taper).

The turn lane warrant analysis indicates that turn lanes are warranted for the following movements under 2027 total conditions (with Phase 2 of the proposed development):

3. EB Right on Route 54 at Site Entrance "A" (100' storage with 100' taper); and
4. WB Left on Route 54 at Site Entrance "A" (100' storage with 100' taper).

The turn lane warrant analysis indicates that turn lanes are warranted for the following movement under 2032 total conditions (with Phase 3 of the proposed development):

5. and WB Left on Route 54 at Site Entrance "B" (200' storage with 200' taper).

Given the posted 45 MPH speed limit and urban classification on Route 54 west of Woodside Lane, the minimum turn lane sizing for turn lanes at Mt. Hermon Road and Site Entrance "A" is 100 feet storage with 100 feet taper. For the WB Left on Route 54 at Site Entrance "B", given the change to rural classification and speed limit of 55 MPH on Route 54 east of Woodside Lane, the minimum turn lane sizing is 200 feet storage with 200 feet taper.

The remaining movements analyzed at Site Entrances "B" and "C" do not meet the warrants for installation of a turn lane under 2027 or 2032 total future conditions (with 100% build out of the proposed development).

Copies of the turn lane nomographs are included in Appendix M.

13.2 SIGNAL WARRANT ANALYSIS OVERVIEW

To address the operational issues associated with the proposed development on Route 54, signal warrant analyses were performed at the intersections of Route 54 with Mt. Hermon Road and with Site Entrance "A". The lane geometry shown in Figures 2-3 and 2-4 (for the 2027 and 2032 analysis, respectively) was used for the purposes of this analysis.

A 12-Hour directional turning movement (DTM) was collected at Route 54/Mt. Hermon Rd in May 2022. These volumes were used for both intersections given the proximity of the intersections and the lack of any entrances or developments between the intersections. The volumes were grown using the approved 1.5% annual growth rate.

For the proposed development, the ITE *Trip Generation Manual*, 11th Edition Time of Day Distributions were used with the proposed development program. Note that Land Use 130 did not have Time of Day Distributions, so Land Use 140 was used. Time of Day Distribution worksheets for the background and proposed traffic volume development are included in Appendix N.

The warrant analyses were conducted following procedures from the 2009 edition of the *Manual on Uniform Traffic Control Devices* (MUTCD) and VDOT signal warrant guidance contained in IIM-TE-387.1 using Highway Capacity Software (HCS) and the hourly volumes from 7:00 AM to 7:00 PM. Warrants 1 (Eight-Hour), 2 (Four-Hour), and 3 (Peak Hour) of the nine (9) signal warrants outlined in the 2009 MUTCD were considered for the analyses.

Copies of the HCS reports are included in Appendix O.

The following six (6) warrants were not in included in this analysis because they are not applicable to the nature/context of the development and/or adjacent roadway infrastructure.

- Warrant 4 – Pedestrian Volume
- Warrant 5 – School Crossing
- Warrant 6 – Coordinated Signal System
- Warrant 7 – Crash Experience
- Warrant 8 – Roadway Network
- Warrant 9 – Intersection Near a Grade Crossing

The MUTCD contains both 100% and 70% volume thresholds that can be used in the signal warrant analysis. The 100% volume thresholds were used to complete the analyses since there are no characteristics supporting the use of the 70% volume thresholds other than that the posted speed limit on Route 54 is above 40 MPH.

13.1 SIGNAL WARRANT ANALYSIS – ROUTE 54 AT MT. HERMON ROAD

Signal warrants for the intersection of Route 54 and Mt. Hermon Road/Frances Road were analyzed in 2027 with completion of Phases 1 and 2 of the proposed development. The total future traffic volumes are shown in Table 12-1 and future lane geometry is shown on Figure 2-3.

Table 12-1: 2027 Total Future Traffic Volumes
Route 54 and Mt. Hermon Rd/Frances Rd

Time	MAJOR SREET						MINOR SREET					
	Route 54 - EB			Route 54 - WB			Mt Hermon Road - NB			Frances Road - SB		
	Left	Through	Right*	Left	Through	Right*	Left	Through	Right	Left	Through	Right
07:00 - 08:00	37	302	92	16	450	6	106	0	9	2	2	26
08:00 - 09:00	26	367	90	7	370	11	99	2	6	1	6	30
09:00 - 10:00	3	247	81	8	333	1	91	1	9	0	0	5
10:00 - 11:00	6	242	86	10	345	0	90	0	4	0	1	9
11:00 - 12:00	11	330	136	8	374	0	124	1	7	0	2	5
12:00 - 13:00	12	423	164	7	401	1	156	2	8	0	2	13
13:00 - 14:00	8	391	135	19	606	5	142	2	11	5	4	29
14:00 - 15:00	20	345	101	11	320	4	125	2	12	3	2	18
15:00 - 16:00	14	411	123	11	425	3	158	2	13	4	4	16
16:00 - 17:00	22	450	121	15	496	4	148	2	13	2	1	24
17:00 - 18:00	16	547	138	17	439	1	146	0	17	2	1	22
18:00 - 19:00	11	368	128	6	310	0	119	1	14	0	2	3

*Dedicated right-turn lanes on major streets can be omitted per Pagones Theorem

The eastbound and westbound approaches of Route 54 include a dedicated right turn lane. The major street right turn volumes (from Route 54) experiences minimal conflict when entering the minor street. Since there is not a substantial conflict, the eastbound and westbound major street right turn volumes were excluded from the traffic signal warrant analysis.

The minor street approaches both operate with, one (1) left-through-right lane. Therefore, the lane geometry used in the traffic signal warrant analysis for the major street was assumed to be two (2) lanes and the minor street was analyzed with one (1) lane.

As shown in Table 12-2, the traffic volumes at the intersection meet the 100% volume thresholds for Warrants 1 and 2.

Table 12-2: 2027 Signal Warrant Summary
Route 54 and Mt. Hermon Rd/Frances Rd

Time Period	Major Street Volume	Minor Street Volume (Highest Approach)	2027 TOTAL FUTURE VOLUMES - 100% WARRANTS					
			#1 (8-hour)				#2 (4-hour)	#3 (Peak Hour)
			Condition A	Condition B	Combination			
					Condition A	Condition B		
07:00 - 08:00	805	115				✓		
08:00 - 09:00	770	107				✓		
09:00 - 10:00	591	101						
10:00 - 11:00	603	94						
11:00 - 12:00	723	132			✓	✓		
12:00 - 13:00	843	166	✓		✓	✓		
13:00 - 14:00	1,024	155	✓	✓	✓	✓	✓	
14:00 - 15:00	696	139			✓			
15:00 - 16:00	861	173	✓		✓	✓		
16:00 - 17:00	983	163	✓	✓	✓	✓	✓	
17:00 - 18:00	1,019	163	✓	✓	✓	✓	✓	
18:00 - 19:00	695	134			✓			
# of Hours Warrant is Met			5	3	8	8	3	0
# of Hours Warrant is Required to be Met			8	8	8	8	4	1
Is Warrant Satisfied?			No	No	Yes		No	No

13.2 SIGNAL WARRANT ANALYSIS – ROUTE 54 / SITE ENTRANCE A

Signal warrants for the intersection of Route 54 and Site Entrance "A" were analyzed for both years 2027 and 2032 with future lane geometry (Figures 2-3 and 2-4). The 2027 analysis was computed with the completion of Phases 1 and 2 of the proposed development. The 2032 analysis was computed with the completion of Phases 1, 2, and 3 of the proposed development. The 2027 total future traffic volumes are shown in Table 12-3 and the 2032 total future traffic volumes are shown in Table 12-4.

Table 12-3: 2027 Total Future Traffic Volumes
Route 54 and Site Entrance A

Time	MAJOR SREET						MINOR SREET		
	Route 54 - EB			Route 54 - WB			Site Entrance A - NB		
	Left	Through	Right*	Left	Through	Right	Left	Through	Right**
07:00 - 08:00	0	188	135	10	426	0	50	0	1
08:00 - 09:00	0	279	106	8	330	0	61	0	1
09:00 - 10:00	0	179	90	6	280	0	66	0	1
10:00 - 11:00	0	169	92	6	285	0	72	0	2
11:00 - 12:00	0	198	167	11	274	0	113	0	2
12:00 - 13:00	0	264	202	13	262	0	156	0	3
13:00 - 14:00	0	283	146	10	502	0	136	0	3
14:00 - 15:00	0	262	116	8	227	0	111	0	3
15:00 - 16:00	0	311	137	10	262	0	179	0	4
16:00 - 17:00	0	374	112	8	382	0	134	0	3
17:00 - 18:00	0	469	123	8	324	0	136	0	3
18:00 - 19:00	0	291	118	7	222	0	99	0	2

*Dedicated right-turn lanes on major streets can be omitted per Pagones Theorem

**per Pagones Theorem for minor street right lane a reduction can be made

Table 12-4: 2032 Total Future Traffic Volumes
Route 54 and Site Entrance A

Time	MAJOR SREET						MINOR SREET		
	Route 54 - EB			Route 54 - WB			Site Entrance A - NB		
	Left	Through	Right*	Left	Through	Right	Left	Through	Right**
07:00 - 08:00	0	189	337	26	466	0	157	0	3
08:00 - 09:00	0	288	266	19	361	0	186	0	3
09:00 - 10:00	0	181	224	16	305	0	196	0	3
10:00 - 11:00	0	171	230	16	311	0	214	0	4
11:00 - 12:00	0	190	417	28	299	0	342	0	6
12:00 - 13:00	0	253	505	33	286	0	476	0	8
13:00 - 14:00	0	282	366	25	544	0	408	0	7
14:00 - 15:00	0	263	291	19	248	0	331	0	6
15:00 - 16:00	0	315	343	24	286	0	498	0	10
16:00 - 17:00	0	385	280	19	416	0	387	0	7
17:00 - 18:00	0	487	308	20	353	0	398	0	7
18:00 - 19:00	0	292	296	17	243	0	310	0	5

*Dedicated right-turn lanes on major streets can be omitted per Pagones Theorem

**per Pagones Theorem for minor street right lane a reduction can be made

The eastbound and approach of Route 54 includes a dedicated right turn lane. The major street right turn volumes (from Route 54) experiences minimal conflict when entering the minor street (Site Entrance A). Since there is not a substantial conflict, the eastbound major street right turn volumes were excluded from the traffic signal warrant analysis. The major street westbound approach has two (2) lanes – one (1) left turn lane and one (1) through lane.

The minor street approach operates with two (2) lanes – one (1) left turn lane and one (1) right turn lane. VDOT methodology includes language for application of Pagone's Theorem which states that right turning traffic from the minor street with a dedicated turn lane can be reduced by a factor of 0.25 when evaluating signal warrants.

Therefore, the lane geometry used in the traffic signal warrant analysis for the major street was assumed to be two (2) lanes and the minor street was analyzed with two (2) lanes.

As shown in Table 12-5, the traffic volumes at the intersection do not meet the 100% volume thresholds for Warrants 1 and 2 in year 2027 with phase 2 of the proposed development. As shown in Table 12-6, the traffic volumes at the intersection do meet the 100% volume thresholds in year 2032 with phase 3 of the proposed development.

Table 12-5: 2027 Signal Warrant Summary
Route 54 and Site Entrance A

Time Period	Major Street Volume	Minor Street Volume (Highest Approach)	2027 TOTAL FUTURE VOLUMES - 100% WARRANTS					
			#1 (8-hour)				#2 (4-hour)	#3 (Peak Hour)
			Condition A	Condition B	Combination			
					Condition A	Condition B		
07:00 - 08:00	624	51						
08:00 - 09:00	617	62						
09:00 - 10:00	465	67						
10:00 - 11:00	460	74						
11:00 - 12:00	483	115						
12:00 - 13:00	539	159						
13:00 - 14:00	795	139				✓		
14:00 - 15:00	497	114						
15:00 - 16:00	583	183			✓			
16:00 - 17:00	764	137				✓		
17:00 - 18:00	801	139				✓		
18:00 - 19:00	520	101						
# of Hours Warrant is Met			0	0	1	3	0	0
# of Hours Warrant is Required to be Met			8	8	8	8	4	1
Is Warrant Satisfied?			No	No	No		No	No

Table 12-6: 2032 Signal Warrant Summary
Route 54 and Site Entrance A

Time Period	Major Street Volume	Minor Street Volume (Highest Approach)	2032 TOTAL FUTURE VOLUMES - 100% WARRANTS					
			#1 (8-hour)				#2 (4-hour)	#3 (Peak Hour)
			Condition A	Condition B	Combination			
					Condition A	Condition B		
07:00 - 08:00	681	160			✓			
08:00 - 09:00	668	189			✓			
09:00 - 10:00	502	199			✓			
10:00 - 11:00	498	218			✓			
11:00 - 12:00	517	348			✓			
12:00 - 13:00	572	484			✓		✓	
13:00 - 14:00	851	415	✓		✓	✓	✓	
14:00 - 15:00	530	337			✓			
15:00 - 16:00	625	508	✓		✓		✓	
16:00 - 17:00	820	394	✓		✓	✓	✓	
17:00 - 18:00	860	405	✓		✓	✓	✓	
18:00 - 19:00	552	315			✓			
# of Hours Warrant is Met			4	0	12	3	5	0
# of Hours Warrant is Required to be Met			8	8	8	8	4	1
Is Warrant Satisfied?			No	No	No		Yes	No

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14 CONCLUSIONS

Analyses were performed for the 2022 existing volumes, the 2027/2032/2038 background volumes (including all background developments and growth), and the 2027/2032/2038 total volumes, which includes site traffic generated by the Iron Horse Business Center development.

14.1 PRINCIPAL FINDINGS

The 2022 existing conditions analysis indicates that the Route 54 corridor operates well during both peak hours. No major queueing or delay challenges are noted at the study intersections, with the exception of the southbound approach failing at Route 54/I-95 SB on/off ramp intersection.

Under 2027, 2032, and 2038 Background analyses, the Route 54 corridor is able to handle increases in traffic volumes without degrading operations until year 2038. By 2038, many movements at Route 54/US Route 1 are over capacity and excessive queues impact operations of the overall intersection.

Phase 1 of the Iron Horse Business Center development (2027) will be accommodated through constructing VDOT-approved standard turn lanes at the intersection of and Mt. Hermon Road with Route 54. Phase 1 consists of the residential townhome development only.

Phase 2 of the Iron Horse Business Center development (2027) will be accommodated through constructing VDOT-approved standard turn lanes at the intersections of Site Entrances A and B with Route 54, increasing the storage to 400 feet for the southbound left/through at the intersection of I-95 SB ramp with Route 54, and installing a traffic signal (or a VDOT approved alternative) at the intersection of Mt. Hermon Road with Route 54. Phase 2 consists of 40% of the overall retail, office, and industrial land uses.

Phase 3 of the Iron Horse Business Center development (2032) will be accommodated through installing traffic signals (or a VDOT approved alternative) at the intersections of Site Entrance A and the I-95 SB ramp with Route 54. The remainder of the site entrances can continue to be served by the improvements constructed during Phase 1 or 2 of development. Phase 3 consists of the remaining 60% of the overall retail, office, and industrial land uses not constructed during Phase 2.

At Route 54/Mt. Hermon Road, the eastbound approach will be modified to have one (1) left turn lane, one (1) through lane, and one (1) right turn lane. The right turn lane will become a drop lane for eastbound traffic. One (1) left turn lane will be added to the westbound approach. At Route 54/Site Entrance A, one (1) left turn lane and one (1) right turn lane will be constructed. At Route 54/Site Entrance B, one (1) left turn lane will be constructed.

With the site improvements described above and under 2027, 2032, and 2038 Total conditions, there are no significant capacity or queueing issues noted at the study intersections beyond those background issues previously noted. Retiming traffic signals along Route 54 will provide added capacity to the corridor. A signal at the Route 54/I-95 SB on/off ramp is able to accommodate the proposed development's trips. The installation of traffic signals on Route 54 at Mt. Hermon Road and Site Entrance A are able to accommodate the proposed site traffic without significantly impacting operations to the mainline of Route 54.

It is understood that any recommended traffic signals will require further signal warrant analysis and a signal justification report at such time that proposed site plan development creates the necessary volumes on Route 54. VDOT approved alternative options for the interchange ramps and Route 54 will need to be reviewed to determine the best solution from a safety and operational perspective.

14.2 RECOMMENDATIONS

The focus of this report is to identify a comprehensive access plan that provides functional access to the site and preserves the capacity of the surrounding roadway network. This report identifies the proposed phasing of the Iron Horse Business Center development and the roadway improvements associated with each phase.

To accommodate the anticipated traffic associated with the Iron Horse Business Center development, the recommended improvement plan is as follows:

- Route 54 at Site Entrance A
  - Phase 2
    - Construct eastbound and westbound left turn lanes.
  - Phase 3
    - Install new traffic signal (or a VDOT-approved alternative).

- Route 54 at Site Entrance B
  - Phase 2
    - Construct westbound left turn lane.

- Route 54 at Mt. Hermon Rd.
  - Phase 1
    - Construct eastbound and westbound left turn lanes.
    - Eastbound right turn lane – modify the eastbound approach to have one (1) left turn lane, one (1) through lane, and one (1) right turn lane. The right turn lane will be a drop lane.
  - Phase 2
    - Install new traffic signal (or a VDOT-approved alternative).

- Route 54 at I-95 SB ramp
  - Phase 2
    - Construct approximately 400' of additional storage for the SB shared left/through lane to accommodate queuing and remove any impacts to mainline I-95 SB.
  - Phase 3
    - Install new traffic signal (or a VDOT-approved alternative).

Given the preliminary nature of the development plan, the exact location of the site entrances along Route 54 (or other internal site roadways) will be defined during the site plan stage. However, it is noted that Site Entrance A must be spaced at least 1,050 feet away (center to center) from Mt. Hermon Road to meet minimum access management standards for spacing between traffic signals. All construction of roadway improvements is subject to Town, County, and VDOT approval, including assistance on obtaining any required right-of-way not owned by the Applicant. Additional entrances to individual parcels within the development, or other modifications to access along Route 54 that may be developed as part of the site plan review process, are not explicitly discussed within this report.